Draft Environmental Assessment

Evaluation of the field efficacy of broadcast application of two rodenticides (diphacinone, chlorophacinone) to control mice (*Mus musculus*) in native Hawaiian conservation areas

Prepared by:
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Cooperating Agencies:
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U.S. Fish and Wildlife Service, Migratory Birds and Habitat Program, Pacific Region

BACKGROUND

In keeping with its mission, the U.S. Fish and Wildlife Service (Service) is striving to recover and restore native species and their habitats in Hawai'i. To achieve this goal it is necessary to remove invasive rodents, including mice, from large geographic areas within the state. However, some of the scientific information needed to support removal of mice from the natural environment is currently lacking. Therefore, the Service, in cooperation with the USDA Animal and Plant Health Inspection Service, Wildlife Services, National Wildlife Research Center (NWRC) are proposing to conduct a study at the U.S. Army Garrison, Pōhakuloa Training Area, Hawai'i to determine the response of mice to different application rates of two rodenticides: diphacinone and chlorophacinone. The Service would provide the funding for the proposed project and the NWRC would conduct the proposed study. Currently, diphacinone is the only rodenticide labeled for conservation purposes in Hawai'i. The information from the study would, if warranted by results, also be used to pursue registration for a conservation label from the Environmental Protection Agency (EPA) for chlorophacinone.

Invasive[1] house mice (*Mus musculus*) are abundant and widespread in Hawaiian ecosystems. Until relatively recently the impacts from mice on birds were considered negligible compared to invasive rats (*Rattus* spp.) (Atkinson 1985; Hilton and Cuthbert 2010 and references therein). However, new research indicates house mice predation on seabirds can have population level effects (Cuthbert and Hilton 2004; Wanless et al. 2007). In Hawai'i, predation from house mice can cause significant injury to native plants, invertebrates, and birds. House mice experience cyclic population irruptions and at Haleakalā National Park are known to exert strong predation pressure on endemic species of invertebrates (Cole et al. 2000). Similarly, mice eat the seeds of the endangered hau kuahiwi (*Hibiscadelphus giffardinanus*) and Haleakalā sandalwood

[1] An "invasive species" means an alien (i.e., non-native) species whose introduction does or is likely to cause economic or environmental harm or harm to human health.

(*Santalum haleakalae*) (Cuddihy and Stone 1990). On Midway Atoll National Wildlife Refuge, mice predation on Laysan and black-footed albatrosses was first documented late 2015 (USFWS 2016). At small spatial scales, mice can be effectively managed by using traps and rodenticides in bait boxes. However, these methods are not cost-effective to employ over large geographic areas. Broadcast application of rodenticides is currently the only way to efficiently control or eradicate mice on a landscape scale.

In recent decades, aerial broadcast methods have been refined to the point where attempts to eradicate rats (*Rattus spp.*) from islands are successful 90% of the time (Howald et al. 2007). Success rates for house mice eradication projects are considerably lower. Failures for mice have been attributed to a number of factors, including incorrect execution of protocols and inadequate coverage of bait (MacKay et al. 2007). Because of differences in rat and mouse home range sizes, population densities, and foraging behavior (Timm 1994; Jacob et al. 2003; Witmer and Jojola 2006), it is very important to select the most appropriate toxicant and bait delivery method to increase the probability of achieving eradication (MacKay et al. 2007). For broadcast application of anticoagulant rodenticides to be effective, the bait must be palatable and applied in sufficient quantity and density so that target animals encounter and ingest a lethal quantity of bait over a successive number of days. The problem of reduced efficacy of rodenticide toxicity and application method is critically important for island eradications where every individual must be exposed to the rodenticide.

Not only must there be sufficient bait available to the rodent, the animal must also be susceptible to the toxicant. Anticoagulant rodenticides are classified as either first generation or second generation. First-generation anticoagulant rodenticides (FGARs) (e.g., warfarin, diphacinone, chlorophacinone) require multiple feedings and are less toxic to rodents and non-target species. Second generation anticoagulant rodenticides are more toxic to both rodents and non-target species, and usually require only a single feeding. Brodifacoum, a second generation rodenticide, has been used for the majority of rodent eradication projects worldwide, including those in the United States. While brodifacoum is a very effective rodenticide and there is potential for using it in Hawai'i in limited situations, it poses a greater risk to non-target species than first-generation rodenticides. Because of this risk to non-target native birds, brodifacoum has not been used for conservation-related rodent control in Hawai'i. Instead, the first-generation rodenticide diphacinone has been used for managing rats and it is currently the only product registered by the EPA for conservation purposes in Hawai'i. While diphacinone has good efficacy for rats, laboratory trials indicate it has reduced efficacy for mice compared to chlorophacinone, another first-generation rodenticide. Chlorophacinone has been used extensively for agricultural and commensal purposes in Hawai'i, but it is untested for conservation of natural resources. This rodenticide has potential application in both control and eradication situations in the State of Hawai'i. However, before chlorophacinone can be registered and incorporated into the management “toolbox” in Hawai’i, it is necessary to conduct trials to assess its efficacy in field environments.

When conducting pest management activities on and off Service lands, we operate under our *Integrated Pest Management* (IPM) policy (569 FW 1). This sustainable approach is consistent with the Department of the Interior’s IPM policy (517 DM 1). The proposed trials are consistent with IPM policy direction and would provide information that would increase effectiveness and reduce risks to non-target species on future rodent management projects sponsored by the Service, and its partner organizations, which is a prime directive of the IPM policy.

The Service also operates under the Migratory Bird Treaty Act (MBTA) in implementing its activities. Federally protected migratory birds may be exposed to the rodenticide, which could result in injury or death of birds. As authorized by the MBTA, the Service may issue Special Purpose permits (50 CFR §21.27) under certain circumstances. Migratory bird permits are issued by the Regional Bird Permit Offices. PIFWO would apply for a Special Purpose permit under the MBTA for the proposed action to address incidental take of MBTA protected species. The permit for this study would be issued by the USFWS Pacific Region Migratory Bird Permit Office in Portland, Oregon. This National Environmental Policy Act (NEPA) review is being conducted partly as a component of the issuance of that permit.

PURPOSE AND NEED FOR ACTION

The purpose of this proposed action is to gather information needed to support our efforts to implement the Endangered Species Act (ESA) of 1973, as amended, which directs Federal agencies to take action to recover endangered species. The information gathered from this proposed action may also improve our abilities to conserve species protected under the MBTA (see Regulatory Framework below). House mice prey on a suite of native Hawaiian plants, invertebrates, and birds and some of these are listed as threatened or endangered under the ESA, or federally protected under the MBTA. To help protect and recover these species and their habitats, rodenticides that enable landscape scale control of mice are necessary. The proposed action is intended to provide data on the relative efficacy of two rodenticides, diphacinone and chlorophacinone, for controlling mice at different application rates in field settings. The proposed action should also provide information necessary for pursuing a conservation registration for chlorophacinone in Hawai’i, if warranted.

The need for the proposed action is to obtain information to: 1) determine the broadcast application rate of diphacinone and chlorophacinone that is necessary to ensure the continued availability of rodenticide baits in a treated area; 2) determine whether or not a specified broadcast application rate of diphacinone and chlorophacinone achieves the desired level of mouse mortality in a field setting; and 3) evaluate the relative efficacy of diphacinone and chlorophacinone at causing mouse mortality in a field setting.

The proposed action would also provide data in support of the Integrated Pest Management Plan (IPM): Programmatic Environmental Impact Statement for the management of invasive rodents and mongoose in Hawai'i. This IPM Plan is a joint effort between the Service and the State of Hawai'i, Division of Forestry and Wildlife, and several cooperating agencies, to provide a framework for land managers to facilitate control and eradication rodents and mongoose in Hawai'i.

A permit under the Migratory Bird Treaty Act for take of migratory birds that might occur incidentally during the conduct of this proposed action is required if an action alternative is selected. This NEPA review is being conducted partly as a component of the issuance of that permit. A consultation under Section 7 of the ESA is also required for this research. The Final EA would serve as the NEPA documentation for issuance of these permits.

DECISIONS TO BE MADE

This EA is will be used by the Service to decide whether or not to hand broadcast the rodenticides diphacinone and chlorophacinone on study plots at Pōhakuloa Training Area (PTA) on Hawai'i Island as proposed, or if the proposal requires further refinement, or if further analyses are needed through preparation of an Environmental Impact Statement (EIS). This EA would also be used to decide whether to issue a Migratory Bird permit to allow the take of migratory birds incidental to the rodenticide study, if implemented. If the proposed action alternative is selected as described, or with minimal changes, and no further environmental analyses are needed, then a Finding of No Significant Impact (FONSI) would be prepared by both the Service and NWRC. Issues raised during the public comment period would be evaluated for consideration to include in the Final EA.

Relevant State and Federal Laws and Executive Orders

The proposed action would be carried out in compliance with the applicable Federal laws and regulations listed below.

National Environmental Policy Act (NEPA) - NEPA requires that Federal actions be evaluated for environmental impacts, that these impacts be considered by the decision maker(s) prior to implementation, and that the public be informed. This EA has been prepared in compliance with NEPA (42 USC Section 4231, et seq.); and the President's Council for Environmental Quality Regulations, 40 CFR Section 1500 – 1508.

National Historic Preservation Act (NHPA) – The NHPA requires: 1) Federal agencies to evaluate the effects of any Federal undertaking on cultural resources, 2) consult with the State Historic Preservation Office regarding the value and management of specific cultural, archaeological and historic resources, and 3) consult with appropriate American Indian tribes or Native Hawaiians to determine whether they have concerns for traditional cultural properties in areas of these Federal undertakings.

Executive Order (EO) 13112 on Invasive Species - Section 2. Federal Agency Duties. (a) Each Federal agency for which that agency's actions may affect the introduction, establishment, or spread of invasive species shall, to the extent practicable and permitted by law,

(1) identify such agency actions;
(2) subject to the availability of appropriations, and within administrative, budgetary, and jurisdictional limits, use relevant agency programs and authorities to:
(i) prevent the introduction, establishment, and spread of invasive species;
(ii) detect and respond rapidly to eradicate or control populations of invasive species in a manner that is cost-effective and minimizes human, animal, plant, and environmental health risks;
(iii) monitor invasive species populations accurately and reliably;
(iv) provide for the restoration of native species, ecosystems, and other assets that have been impacted by invasive species;
(v) conduct research on invasive species and develop and apply technologies to prevent their introduction, and provide for environmentally sound methods of eradication and control of invasive species;
(vi) promote public education and action on invasive species, their pathways, and ways to address them, with an emphasis on prevention, and early detection and rapid response;
(vii) assess and strengthen, as appropriate, policy and regulatory frameworks pertaining to the prevention, eradication, and control of invasive species and address regulatory gaps, inconsistencies, and conflicts;
(viii) coordinate with and complement similar efforts of States, territories, federally recognized American Indian tribes, Alaska Native Corporations, Native Hawaiians, local governments, nongovernmental organizations, and the private sector; and
(ix) in consultation with the Department of State and with other agencies as appropriate, coordinate with foreign governments to prevent the movement and minimize the impacts of invasive species; and…”

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) - FIFRA requires the registration, classification, and regulation of all pesticides used in the United States. The Environmental Protection Agency (EPA) is responsible for implementing and enforcing FIFRA. All chemical methods integrated into any selected program as implemented by the Service or other cooperating agencies must be registered with and regulated by the EPA (FIFRA Section 3).

Endangered Species Act (ESA) - It is Federal policy, under the ESA, that all Federal agencies shall seek to conserve endangered and threatened species and shall utilize their authorities in furtherance of the purposes of the ESA (Sec.2(c)). Section 7 consultations are conducted between action agencies and the Service to ensure that "any action authorized, funded, or carried out by such an agency . . . is not likely to jeopardize the continued existence of any endangered or threatened species… each agency shall use the best scientific and commercial data available" (Sec. 7(a)(2)).

Migratory Bird Treaty Act (MBTA) - The MBTA implements obligations within the United States to conserve and protect species agreed to under four international treaties. The MBTA protects 1027 species of birds, including most of the species that are native on Hawai'i and species introduced to Hawai'i that have MBTA protection elsewhere. The MBTA provides that it is unlawful to pursue, hunt, take, capture, kill, possess, sell, purchase, barter, import, export, or transport any migratory bird, or any part, nest, or egg of any such bird, unless authorized under a permit issued by the Secretary of the Interior.

Executive Order 13186 – Responsibilities of Federal Agencies to Protect Migratory Birds. (66 FR 3853, Jan. 17, 2001) It requires federal agencies, to the extent practicable, to avoid or minimize adverse impacts on migratory bird resources when conducting agency actions, and to restore and enhance the habitat of migratory birds. Specifically, it requires federal agencies to develop and use principles, standards, and practices that will lessen the amount of unintentional take reasonably attributed to agency actions.

State of Hawai'i Administrative Rules – Title 13 Department of Land and Natural Resources, Subtitle 5 Forestry and Wildlife, Part 2 Wildlife,

- Chapter 122, Rules Regulating Hawai'i Game Bird Hunting, Field Trials, and Commercial Shooting Preserves;
- Chapter 123, Rules Regulating Game Mammal Hunting in General;
- Chapter 124, Indigenous wildlife, endangered and threatened wildlife, injurious, wildlife, introduced wild birds, and introduced wildlife, Subchapter 4, Scientific, propagation, and educational permits. Permits for collecting, possessing, killing, selling or offering for sale, and transporting indigenous wildlife, introduced wild birds, game birds, or game mammals may be issued by the board or its authorized representative for scientific or educational purposes including cultural activities, or for activities that will enhance the survival of the wildlife species. PIFWO would apply for a Protected Wildlife Permit for Scientific Research for the collection of native and non-native birds protected by the State of Hawai'i. Incidental take would be covered under the collection authorization.

Hawai'i Department of Agriculture, Pesticides Branch – The Pesticides Branch has at their discretion the authority to inspect any site where pesticides are being used.

SCOPING AND ISSUES SELECTION

Internal scoping was conducted by the Service. Issues were identified related to migratory bird permitting, and include: (1) Whether or not the proposed action includes appropriate avoidance, minimization, and mitigation measures to safeguard migratory birds and (2) whether or not there is a sufficient showing of benefit to the migratory bird resource from the study, as required under 50 CFR 21.27 and 50 CFR 13.21. Issues were also identified related to other resources and concerns, and these include: What effects the proposed action would have on biological resources, including effects to species listed under the Endangered Species Act, wetland and water resources, recreation, human health and safety, and cultural resources.

All of these issues are analyzed in detail below (Environmental Consequences section). Any comments we receive during the public comment period on the Draft EA regarding issues would be addressed in the Final EA.

ACTION ALTERNATIVES

This section describes the No Action Alternative and the Proposed Action Alternative.

<u>Alternative A</u> - No Action

Under Alternative A, the proposed study would not occur.

<u>Alternative B</u> - Trial with both diphacinone and chlorophacinone (Proposed/Preferred Action)

Under Alternative B, NWRC staff would conduct the study to compare the operational broadcast efficacy of 0.005% diphacinone (D-50) and 0.005% chlorophacinone (Rozol) toxic baits to mice. The purpose of this comparison is to refine the optimal application rates for these toxic grain-based baits and to evaluate their individual and relative effectiveness for achieving mouse control in a field environment. NWRC would be working under an Inter-agency Agreement with PIFWO.

This work would be conducted within the Mixed Tree and Nāʻōhuleʻelua Fence Units at PTA, U.S. Army Garrison, on the northwestern slope of Mauna Loa on the Island of Hawai'i, Hawai'i (Fig. 1). Study plots would be situated approximately 3.5 km from the northwest boundary fence of the units and 2.8 km from the southwest boundary fence.

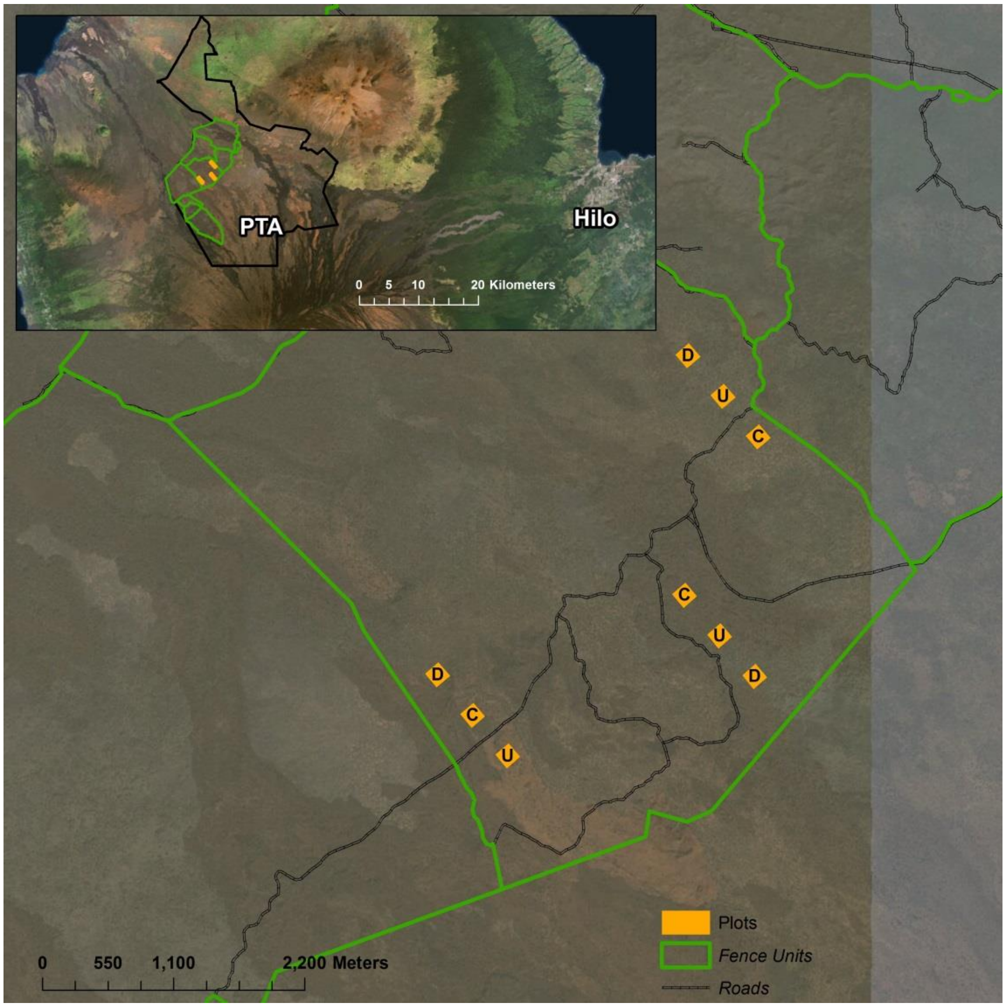

Figure 1. Research site map with a sample of a potential randomization scheme. Each box represents a 150m x 150m treatment plot with a 60 m x 60 m core trapping/tracking area, with 300 m between plots. C = chlorophacinone D = diphacinone 50, U = untreated control (no bait application). Actual plot locations may vary depending on suitability of the terrain. Green lines indicate ungulate fences; black lines are roads. Inset: Island of Hawai'i, with western ungulate-fenced management units in green and black border depicting extent of the Pōhakuloa Training Area.

The study design would incorporate nine plots grouped into three blocks of three plots (Fig.2). Each plot in a block would be randomly assigned to one of three treatments: C = chlorophacinone, D = diphacinone, or U = untreated control (no bait application). Treatment plots would measure 150 m x 150 m (2.25 ha) and be spaced at least 300 meters apart to limit potential migration of mice between plots.

The proposed project would be begin in May or June of 2017 and extend through October 2017. Project delays may require that all or a portion of the project be conducted during a later timeframe (within the mitigation measures listed below); all work will be concluded prior to

October 2018. During each round of trials, the three plots within one block would be assessed simultaneously (Fig. 2). Treated plots would receive two applications of bait separated by approximately 8 days (see below). After the first block of three plots is completed, these same procedures would be followed at a second block (second replicate). The first application rate for the second block would be at the same rate as the first block or adjusted up or down based on the results from the first block. As with the first block, the second application rate would be determined by the bait persistence rate following the first application. After the second block is completed, treatment and monitoring of the third and final block would begin. All activities in the untreated control plots would be identical to those in the rodenticide treatment plots, except for the application of rodenticide.

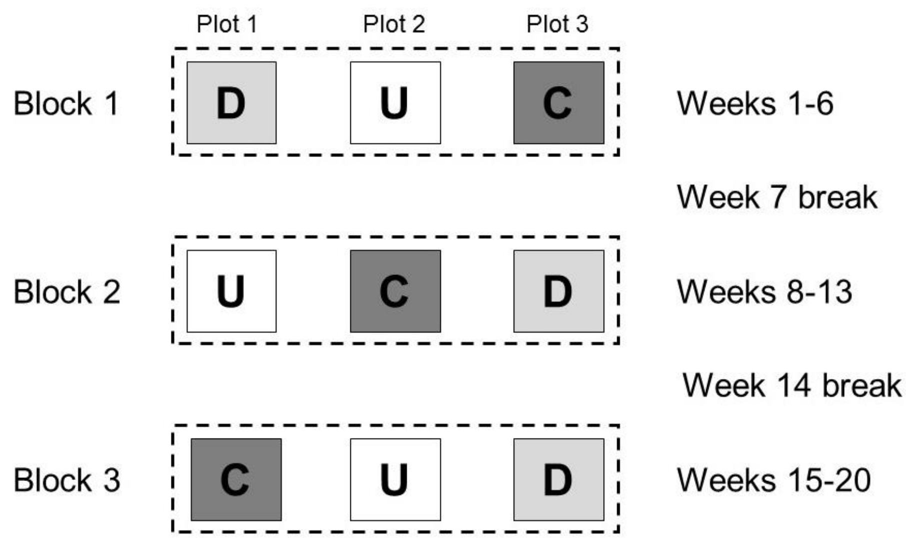

Figure 2. Conceptual diagram with three plots to be tested simultaneously within each block, with blocks to be tested sequentially. D = diphacinone (D-50), C = chlorophacinone (Rozol), and U = untreated control plot.

The application rate of bait for this study would be 22.4 kg/ha and is based on data from a previous trial using biomarkers in placebo bait (Pitt et al. 2013). This rate is approximately twice the labelled rate of D-50 for rats (11.1 to 13.8 kg/ha) and Rozol for voles (11.2 kg/ha), and is authorized under a supplemental label and Experimental Use Permits (EUP) from the EPA, respectively (see Appendix 1: **to be inserted before draft submission**). For the purpose of determining quantities to be approved under an EUP for Rozol and a supplemental label for D-50, it is assumed that both applications at each of the three replicates would occur at this

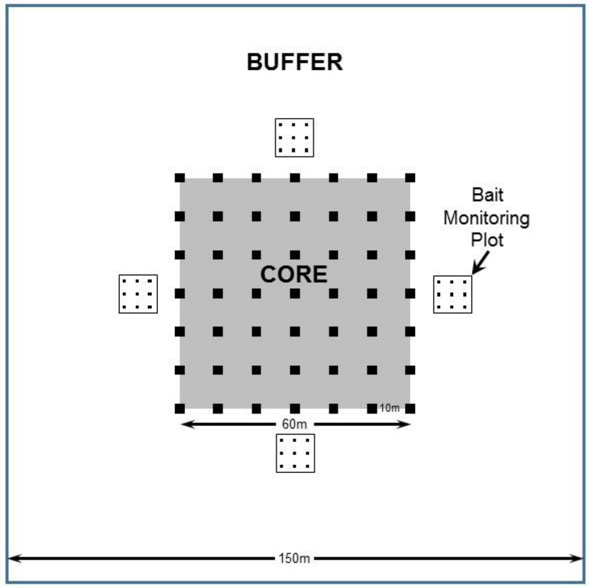

Figure 3. Schematic of 150 x 150m plot layout with 60 x 60 m core trapping grid of 49 traps spaced 10 m apart. Four sub-plots would be monitored for bait persistence.

maximum rate (2.25 ha plot x 3 replicates x 2 applications x 22.4 kg/ha = 302.4 kg total maximum application per product). However, actual application rates would be modulated based on bait persistence rates observed during post-treatment bait monitoring occurring within the four bait monitoring subplots inside each treatment plot. Bait persistence throughout the first application in each plot would guide the application rate for the second application, ensuring that sufficient, but not excessive bait remains for the entire treatment period. Bait persistence results from the first replicate would guide the application rate for the second replicate, and so on. Results from the previous trial (Pitt et al. 2013) recommended an 8 to 14 day interval between treatments. The second application would be conducted after 8 days, at a rate ensuring continuous availability of bait for 16+ days.

On the D and C treatment plots, personnel (4-6) would walk abreast along pre-established parallel transects spaced at 10 m apart. They would hand cast bait over a 5-m swath on either side of transects. Prior to actual bait application, all personnel would practice dispensing untreated placebo pellets in an area remote from study plots to simulate hand bait broadcast at the targeted application rate.

The fate of bait pellets on the ground would be monitored within four 5 m x 5 m grids established on the perimeter of mouse trapping grids (described below; Fig. 3). Bait condition (weathering, mold) and fate (disappearance, or partial consumption by mollusks, invertebrates, etc.) of randomly placed and labeled pellets in each plot would be recorded on the first and every other day for 8 days after each bait application. Pellets to be monitored would be placed at a density commensurate with the treatment's application rate. These data would determine whether unspoiled bait is available throughout the 8-day exposure period of a single broadcast application of bait. Digital trail cameras may also be used to identify bait visitors and document bait fate.

Changes in mouse populations before and after baiting would be assessed using radio-telemetry and tracking stations. Prior to baiting, mice would be live-captured on the 60 x 60 m mouse trapping grid centered in each treatment plot (Fig. 3). Numbered traps would be set at 10-m intervals within the core trapping grid of each treatment plot, totaling 49 mouse traps / grid. Traps would be checked daily shortly after sunrise. All captured mice would be anesthetized, uniquely identified with injectable microchips, and released at the original capture location. Date, trap number, sex, body weight, and reproductive status would be recorded for each capture. Injured or otherwise unhealthy rodents would be euthanized in the field by anesthesia overdose or cervical dislocation. Non-target captures would be recorded and released onsite.

Depending on capture success and composition, 10-12 mice of equal sex ratio would be radio-collared in each plot. The target maximum number of mice to be micro-chipped per plot is 30, of which 10-12 would also be collared with miniature radio transmitters. Animals would be located daily for approximately 4 days prior to and up to 10 days after the last bait application to determine bait efficacy (mortality). GPS coordinates and the closest trap location to the target transmitter signal would be recorded. Radio-tagged mice re-captured during the 10-14 days initial capture/mark/release period would be released at the site of capture. Post-treatment re-captures of micro-chipped mice may also be used as an indicator of survival.

Baited and inked tracking stations would be used to record mouse activity (Lord et al. 1970; Marten 1972) in each plot. Stations (49 per plot) would be deployed at 10-m spacing on the ground within the core trapping for a period of 4 days before and up to 10 days after baiting. Daily checks would be made and stations serviced as needed. Plot number, date, tracking station number and presence or absence of mouse tracks would be recorded for each station.

After completion of radio tracking and mouse activity monitoring, follow-up trapping would be conducted for four to eight nights at all trap grid locations at all plots. Results from this trapping effort may serve as a third indicator of relative effect of treatments. Recovered microchips would indicate mice caught in the preparatory trapping that survived the treatment. Captured animals would be euthanized, collected, and labeled with the capture date, trap location, species, and sex and transported to the NWRC Hawai'i Field Station.

To evaluate levels of rodenticide residues in target (mouse) and non-target organisms, carcasses opportunistically found within the study plots would be collected. Mouse carcasses would be examined for evidence of microchips, bait consumption (presence of bait material in the stomach and GI tract), and symptoms of anticoagulant poisoning (hemorrhaging). Attempts would be made to recover confirmed or suspected mortalities (stationary for 3 consecutive days) of radio-tagged mice from underground burrows or other locations. The exact locations (GPS) of visual sightings or recovered carcasses would be recorded. All recovered carcasses would be tested for rodenticide content to confirm mortality due to exposure. Additionally, any non-target carcasses found during field activities would be collected and stored frozen until chemical analytical tests can be performed to detect the presence of diphacinone or chlorophacinone residues. Twenty mice would be collected and euthanized from the study site (outside of treatment plots) prior to any rodenticide applications to get a baseline of potential pre-treatment environmental rodenticide exposure and to strengthen the inference that mortalities were due to the treatment rather than prior exposure. The proportion of radio-tagged mice that succumbed to the baiting, and of those that survived, would be calculated for each treatment plot, and averaged across treatments for each rodenticide, and evaluated relative to the application rate.

Mitigation

To prevent or eliminate environmental harm from the proposed action, several mitigation measures would be incorporated into Alternative B as follows:

1) The location of PTA was carefully selected to avoid and minimize the risk of poisoning to non-target species, including migratory birds and species listed as federally threatened or endangered. Monitoring data suggest that abundance of native species of concern [i.e., Hawaiian goose or nēnē, (*Branta sandvicensis*), Hawaiian hawk or ʻio (*Buteo solitarius*), and Hawaiian short-eared owl or pueo (*Asio flammeus sandwichensis*)] is very low in the study area.
2) The study would be conducted outside the main game bird season, which normally begins on the first Saturday in November and extends through the last Sunday in January. Avoiding the hunting season would eliminate the possibility of hunters interacting with birds that may have ingested rodenticide. (The actual risk to human health from such interactions is very low; this mitigation measure may not be possible in future management actions, as such this should not be seen as precedent.);
3) During all phases of the study, project staff would monitor for species of concern (see #1). Depending on daily activities, 0 to 8 personnel will be on site 2 to 10 hours between 0700 and 1700 hours any day of the week. If individuals of these species are observed in or near the affected area they would be hazed by shouting, rapid approach by project

staff, or both. If a bird or location requires three or more hazing events, the project lead would immediately contact the PIFWO project officer who would then discuss options with PIFWO's Recovery staff and personnel within the Division of the Migratory Birds and Habitat Program.

4) If behavior of any bird species of concern indicates that a nest is in the area, the project lead would immediately contact the PIFWO project officer who would communicate with Migratory Birds personnel on a course of action. Migratory Birds would provide a recommendation based on the species, nest status, and other pertinent information.
5) During project activities, any native bird or mammal species, that is exhibiting abnormal behavior (e.g., toxicosis) would be collected and delivered to a permitted rehabilitation center for therapeutic treatment. The Migratory Bird Permit Office would provide a list of federally permitted rehabilitators in Hawai'i.
6) Any non-native MBTA-protected bird, that is exhibiting abnormal behavior (e.g., toxicosis) would be treated as in #5 above or euthanized (Leary et al. 2013). That decision would be at the discretion of the project lead and based on the condition of the bird;
7) Any incident of hazing, observations of species of concern, or delivery of a native animal to a rehabilitation center would be reported within 24 hours to the PIFWO project officer who would report the incident to the Migratory Bird Permit Office as stipulated in the permit conditions. Interactions under #6, would not require contacting the PIFWO project officer, but would be included in the project report;
8) If a tree (or other natural or human produced feature) is found to be an attractant to a species of concern, then the feature would be modified in a non-damaging manner (e.g., flagging or netting attached) to reduce the attractiveness. If the tree is a listed species, then an endangered plant biologist would be consulted;
9) To prevent impact to protected plants, PTA staff would mark the locations of listed species. Additionally, project staff would be informed of listed species in or near the affected area, provided with pictures or drawings of these species, and instructed to avoid walking on or disturbing any plants in or near the affected area;
10) To protect cultural resources, project staff would be instructed to avoid lava tube entrances and not disturb surface rocks. Lava tube entrances are known to contain cultural resources and surface rocks may comprise cultural sites.

Mitigation considered and rejected

1) The use of deterrents to keep species of concern out of the affected area other than the active hazing and habitat modification described above was determined to be unfeasible or ineffective. Sound-based deterrents (e.g., cannons, exploders) would not

be appropriate for the action and may pose a risk to species or the habitat. Visual deterrents have not been demonstrated to be effective.

Alternatives Considered and Dismissed from Detailed Analysis

Trials to assess toxicity on house mice in the field using only diphacinone or only chlorophacinone were considered, but were dismissed from detailed analysis. Field data for both rodenticides is needed to evaluate the effectiveness of the products and it is important that the data for both products be collected concurrently. Environmental variables, such as rainfall, influence growth of vegetation and population levels of invertebrates, resources that affect house mice population dynamics. Because weather and environmental factors influencing mouse population levels vary considerably with season and year, it is possible that data on rodenticide efficacy collected from trials conducted separately would not be comparable.

Hawai'i Volcanoes National Park (HAVO) was considered as a potential site to conduct the project. After evaluating the risks to non-target species, it was determined that the risk of secondary poisoning to the Hawaiian hawk or 'io (*Buteo solitarius*) through the consumption of intoxicated rodents was too great. Therefore, HAVO was removed from further consideration.

Midway Atoll was considered as a potential site to conduct the project. The relatively small size of the atoll would not allow the sufficient spacing of treatment plots and blocks to achieve the independence required for rigorous experimental design. The ability to compare results between replicates would also be compromised because of the heterogeneity of the habitat across Sand Island. Additionally, the expense associated with transporting personnel and equipment to and from the island, combined with the additional cost of lodging would make the project cost prohibitive. Therefore, Midway Atoll was removed from further consideration.

AFFECTED ENVIRONMENT

This section describes the environment that would be affected through implementation of the No Action Alternative and the Proposed Action Alternative. The affected area is defined as the geographic area where the proposal's effects to natural, cultural, and human resources may occur. All of PTA is considered in the discussion of the affected environment; however, environmental consequences (i.e., the affected area) are restricted to the treatment plots and a distance extending 2.7 km out from the treatment plots. This represents the closest distance to the PTA perimeter fence (i.e. southwest boundary). Species considered in the affected environment and environmental consequences include those that may not occur in the area, but have a reasonable potential to move into the area during the study period.

Components of the environment such as Mineral Resources, Livestock Grazing/Ranching, Rights-of-Way/Realty Actions, Local Socio-Economic Parameters, and Environmental Justice (EO 12898) are not considered further because the land management status of the military base precludes these interests.

The study would occur in lands the Department of the Army (Army) has designated as a training area (TA 22). This training area is used for limited training. Ground training occurs infrequently and is limited to a few helicopter insertions. Live fire does not occur at the firing points in TA 22. The purpose of the area is to offset the ecological impacts of training at PTA. TA 22 is enclosed by large-scale fencing that is in compliance with a biological opinion under the ESA (USFWS 2003). The fencing prevents ingress of ungulates, whose numbers have been suppressed by control activities inside the fenced area. These efforts reduce browsing and grazing pressure on listed and native plants within the fenced units.

Physical Characteristics

Average annual precipitation at the PTA weather station is 14.4 inches, with most rainfall occurring January through March. Annual mean temperature is about 50°F near the cantonment area, which is just off Saddle Road on the NW edge of PTA. Average daily temperatures vary about 30°F, with lows reaching below 50°F and highs about 80°F. Topography in the study area is relatively flat with about a 4% grade across the treatment plots. The habitat is comprised of sparsely-vegetated shrubland and woodland on primarily ʻaʻa and pāhoehoe lava substrate. The proposed study is scheduled to be conducted primarily during the dry season, though the risk analyses presented here would be equally applicable at any time of year.

Biological / Ecological Resources

Vertebrates Listed under the Endangered Species Act

Several species of native and non-native birds and mammals have been documented on PTA during surveys since 1991 (U.S. Army Garrison 2010; PIFWO 2016). Of these, ten are protected under the ESA. Five of these have been recorded within the last ten years: the Hawaiian hoary bat or ʻōpeʻapeʻa (*Lasiurus cinereus semotus*), Hawaiian goose or nēnē, (*Branta sandvicensis*), Hawaiian hawk or ʻio (*Buteo solitarius*), Hawaiian petrel or ʻuaʻu (*Pterodroma sandwichensis*), and band-rumped storm petrel or ʻakēʻakē (*Oceanodroma castro*). Another four species of ESA-listed birds that were historically present near or on the base have not been observed for almost 30 years: the palila (*Loxioides bailleui*), Hawaiian crow or ʻalalā (*Corvus hawaiiensis*), ʻākepa (*Loxops coccineus coccineus*), and Hawai'i creeper (*Oreomystis mana*). A single individual of the ESA-listed ʻakiapōlāʻau (*Hemignathus munroi*) was sighted in 1995. The ʻiʻiwi (*Vestiaria* *coccinea*) is being proposed for ESA listing and is reported from forested areas, but is extremely rare on PTA. Since 1992, only one bird was detected in 1992 on Kīpuka ʻAlalā in 1992 (Schnell 2017).

Birds Protected by the MBTA that are not listed under the ESA

Six additional native bird species that occur on PTA are protected by the MBTA, but not the ESA: Pacific golden plover or kōlea (*Pluvialis fulva*), Hawaiian short-eared owl or pueo (*Asio flammeus sandwichensis)*, ʻamakihi (*Hemignathus virens virens)*, ʻapapane (*Himatione sanguinea)*, ʻōmaʻo (*Myadestes obscurus)*, and sanderling (*Calidris alba*). Another six birds, all non-native species introduced from mainland U.S., occur in the area and are also protected by the MBTA: barn owl (*Tyto alba*), house finch (*Haemorhous mexicanus*), northern cardinal (*Cardinalis cardinalis*), northern mockingbird (*Mimus polyglottos*), Eurasian skylark (*Alauda arvensis*), and mourning dove (*Zenaida macroura*). The latter is also a game bird (see below).

Game birds and mammals

Thirteen game birds, all non-native species, have been recorded from PTA: zebra dove *(Geopelia striata)*, spotted dove *(Streptopelia chinensis)*, chestnut-bellied sandgrouse *(Pterocles exustus)*, California quail *(Callipepla californica)*, Japanese quail *(Coturnix japonica)*, kalij pheasant *(Lophura leucomelana)*, chukar *(Alectoris chukar),* wild turkey *(Meleagris gallopavo)*, ring-necked pheasant *(Pharianus colchicus)*, Erckel's francolin *(Francolinus erckelii)*, black francolin *(Francolinus francolinus)*, grey francolin *(Francolinus pondicerianus)*, and mourning dove. These birds are afforded protection under Hawai'i State game regulations (DOFAW 2002).

Four introduced game mammals also occur on PTA: feral pig (*Sus scrofa*), feral goat (*Capra hircus*), feral sheep (*Ovis aries*), and mouflon sheep (*Ovis gmelini musimon*).

State protected, non-game birds

Twelve species of native and non-native birds, that occur in the area, which are not game species, are protected by the State of Hawai'i: ʻelepaio (*Chasiempis sandwichensis sandwichensis),* rock pigeon (*Columba livia*), African silverbill (*Euodice cantans*), common myna (*Acridotheres tristis*), House sparrow (*Passer domesticus*), Japanese bush-warbler (*Cettia diphone*), lavender waxbill (*Estrilda caerulescens*), nutmeg mannikin (*Lonchura punctulata*), red-billed leothrix (*Leiothrix lutea*), saffron finch (*Sicalis flaveola*), and yellow-fronted canary (*Serinus mozambicus*).

Vertebrates Without Protected Status

Five species of invasive mammal and 1 introduced bird, with no protected status, are reported from PTA: feral dog (*Canis lupus familiaris*), feral cat (*Felis catus*), small Indian mongoose (*Herpestes auropunctatus*), black rat (*Rattus rattus*), house mouse (*Mus musculus*), and Japanese white-eye (*Zosterops japonicus*).

Invertebrates With Protected Status

One federally listed species of invertebrate has been reported on PTA, the yellow-faced bee (*Hylaeus anthracinus*) (Magnacca 2007; U.S. Army Garrison 2010; PIFWO 2016). A single specimen was collected on surveys conducted from 1999 to 2002.

Plants With Protected Status

Twenty species of federally listed plants occur on PTA (Doratt 2016a). These same species are State-listed. Of these 20 species, four are reported to occur within 50 meters of the study plots: *Festuca hawaiiensis* (Hawaiian fescue), *Kadua coriacea* (kioʻele), *Stenogyne angustifolia* (creeping mint), and *Zanthoxylum hawaiiense* (aʻe).

<u>Wetlands and Water Resources</u>

There are no perennial surface streams, lakes, or other water bodies within PTA's boundaries due to low annual precipitation, porous soils, and lava substrates. There are perennial streams downslope from the affected area and the nearest downslope non-perennial stream is approximately 9 km from the affected area.

<u>Recreation</u>

Public access to PTA for outdoor recreational activities and the harvest of game animals is permitted when compatible with environmental conditions or restrictions and the objectives of sustained multiple-use and the continued accomplishment of the military's mission. Public access is limited and by permission and permit only (U.S. Army Garrison 2010).

<u>Human Health and Safety</u>

There is minimal human presence on or near the study site. Human activities include occasional military training and biological monitoring. Risk to human health and safety arising from this project would be to personnel involved in the study and to hunters from outside of PTA consuming poisoned game.

Cultural / Archaeological Resources

PTA is rich with Native Hawaiian archeological resources. Thirteen archaeological sites are known to occur within 150 m of the proposed study plots, with several being inside the plot boundaries. All of these thirteen known sites are in lava tubes. Additionally, unidentified archaeological sites, represented as nondescript assemblages of surface rocks, may occur in the affected area.

RODENTICIDE TOXICITY AND EXPOSURE

Risk of rodenticide poisoning for an animal is based on both the toxicity of the chemical and its exposure to the chemical. Exposure can arise from directly ingesting the rodenticide (i.e., primary exposure) or eating an animal that has ingested the rodenticide (i.e., secondary exposure). For the purposes of this EA, exposure is a function of the quantity of the rodenticide in the environment and the frequency of occurrence of the animal in the environment where the rodenticide is applied. The former is addressed with the application rate and the latter is addressed in the Affected Environment and Environmental Consequences sections when animal distribution and abundance in the affected area are discussed. Toxicity is taxa specific and is determined by the quantity of active ingredient (ai) for a given body weight (bwt) to achieve a certain effect, usually measured as mg ai / kg bwt. Toxicity is most frequently represented as the LD_{50} (i.e., acute oral toxicity) and LC_{50} (i.e., dietary toxicity). LD_{50} is the chemical dose where 50% of the test animals died and is usually administered as a single dose. LC_{50} is the concentration of the chemical in feed where 50% of the test animals died and the test is usually administered over a multi-day period (e.g., five to 10 days). A third measure of toxicity is the LLD, the lowest lethal dose of a chemical at which a test animal died. The lower the LD_{50}, LC_{50}, or LLD value, the more toxic the chemical, or more sensitive the species. LD_{50}, LC_{50}, and LLD measure the lethality of a chemical to the subject species. Toxicants are also evaluated based on their sublethal effects on animals. These are represented by metrics such as NOEL (no observable effect level) and LOEL (lowest observable effect level). NOEL is the is the highest dose or exposure level of a toxicant that produces no measureable toxic effect on the test group of animals and LOEL is the lowest dose or exposure level of a toxicant that produces a measurable toxic effect on the test group of animals. Sublethal effects observed in the anticoagulant acute oral studies included lethargy, subcutaneous, intramuscular, and internal hemorrhaging, piloerection, diarrhea, bloody diarrhea, and anorexia (Anderson et al. 2011).

It is recognized that the LD_{50} is a poor measure of toxicity for first generation anticoagulant rodenticides (FGARs) (Jackson and Ashton 1992). FGARs are designed to deliver a lethal dose over multiple days of feeding, whereas LD_{50} results are obtained by giving different groups of test animals a single dose of varying quantities of the chemical via gavage. This has been found to underestimate the toxicity of FGARs. The LC_{50}, LLD, LOEL, and NOEL are more accurate metrics of the sensitivity of birds and mammals to FGARs.

Individual species of birds and mammals vary in their relative sensitivity (i.e., the toxicity) to different rodenticides. For mammals, chlorophacinone and diphacinone are considered "very highly toxic" as measured by acute oral toxicity (LD_{50}) and dietary toxicity (LC_{50}) (Anderson et al. 2011). For birds, the acute oral and dietary toxicity of chlorophacinone is considered "moderately toxic" and "highly toxic," respectively. Diphacinone for birds is considered "slightly toxic" (acute oral) and "moderately toxic" (dietary toxicity). It is important to note that descriptors such a "slightly toxic," "moderately toxic," "highly toxic," etc., are used without consistent standards and hold little value for comparison across studies.

Table 1. Acute and sublethal dietary risk to mammals from primary exposure to diphacinone (0.005%) pellets or through secondary exposure from eating invertebrates or rodents exposed to diphacinone bait. Calculated values are the grams of bait or prey required to be ingested to equal the lowest reported mammalian LD_{50}, NOEL, and LOEL ("na" is not applicable). Adapted from Eismann and Swift (2006).

Acute Exposure				
Species	Weight (kg)	LD50 (mg/kg)	Primary Exposure (g/day)[1]	Secondary Exposure (g /day)[2]
Dog	15.0	0.6[3]	180	2,932
Cat	3.60	15	1,080	17,590
Bat	0.017	0.91[4]	na	3.09[5]
Pig	50.0	>150	>150,000	>2,442,997

Sublethal Exposure							
Species	Weight (kg)	Sublethal Toxicity (mg/kg/day)[6]		Primary Exposure (g/day)[6]		Secondary Exposure (g/day)[2]	
		NOEL	LOEL	NOEL	LOEL	NOEL	LOEL
Dog	15.0	0.040	0.085	12.00	25.40	195.44	415.31
Cat	3.60	0.040	0.085	2.88	6.12	46.91	99.67
Bat	0.017	0.040	0.085	na	na	0.14[5]	0.29[5]
Pig	50.0	0.040	0.085	40	85.0	651.47	1384.36

1 Based on a diphacinone concentration in Ramik® Green of 50 mg/kg
2 Based on the highest diphacinone residue found in pig liver (3.07 mg/kg, Pitt et al. 2005)
3 Based on the LD50 for the coyote (Savarie et al. 1979)
4 Based on the LD50 for the vampire bat (Thompson et al. 1972)
5 Based on the highest diphacinone residue detected in living animal tissue (mollusk, (5.01 mg/kg, Johnston et al. 2005)
6 Based on the NOEL and LOEL observed in rats (Rogers 1994 in; US EPA 1998)

The potential ecological and human health risks associated with broadcasting diphacinone in native Hawaiian ecosystems have been examined (Eisemann and Swift 2006) and the results relevant to the proposed action have been adapted and presented in Tables 1 and 2. As discussed above, the application rate of both rodenticides would be 22.4 kg / ha. Diphacinone pellets average about 0.15 g each, which translates into approximately 329,400 pellets / plot or 14.6 pellets / m^2. Chlorophacinone pellets average about 0.31 g each, which would translate into approximately 162,581 pellets / plot or 7.23 pellets / m^2. Total active ingredient of both

Table 2. Acute and sublethal dietary risk to birds from primary exposure to Ramik® Green pellets or through secondary exposure from eating contaminated invertebrates or rodents. Calculated values are the grams of bait or prey required to be ingested to equal the lowest reported avian LD50, LLD, and LOEL ("na" is not applicable). Kōlea values extrapolated from non-game bird values based on weight of bird.

Acute Exposure							
Species	Weight (kg)	LD50 (mg/kg)	LD_{50} Primary Exposure (g / day)[1]	LD_{50} Secondary Exposure (g / day)[2]	Lowest Lethal Dose (LLD) (mg/kg/day)[4]	LLD Primary Exposure (g)[2]	LLD Secondary Exposure (g)[3]
Game bird	1.00	>400	>8,000	>79,840	2.3	46.00	458.72
Non-game bird	0.03	>400	>240	>2,395	2.3	1.38	13.76
Pueo (ad.)	0.35	>400	na	>45,603[5]	0.8	na	85.50[5]
Pueo (ck.)	0.19	>400	na	>24,756[5]	0.8	na	46.41[7]
Kōlea	0.14	>400	na	>18,241	2.3	6.44	64.22
Nēnē	1.50	>400	>12,000	>119,760	2.3	69.00	688.08

Sublethal Exposure (LOEL)				
Species	Weight (kg)	LOEL Sublethal Toxicity (mg/kg/day)[6]	LOEL Primary Exposure (g / day)[2]	LOEL Secondary Exposure (g / day)[3]
Game bird	1.00	0.11	2.20	21.96
Non-game bird	0.03	0.11	0.07	0.66
Pueo (ad.)	0.35	0.11	na	12.54[5]
Pueo (ck.)	0.19	0.11	na	6.81[7]
Kōlea	0.14	0.11	0.31	3.07
Nēnē	1.50	0.11	3.30	32.93

1 Based on the northern bobwhite LD50 (Campbell et al. 1991 summarized in; US EPA 1998)
2 Based on the diphacinone concentration in Ramik® Green (50 mg/kg)
3 Based on the highest diphacinone residue found in living animal tissue (mollusk, 5.01 mg/kg, Johnston et al. 2005)
4 Based on data from Rattner et al. (2012), which included a reanalysis of data from Long et al. (1992); LLD for animal that died on day 3.
5 Based on the highest diphacinone residues found in pig liver (3.07 mg/kg, Pitt et al. 2005)
6 Based on the LOEL observed in golden eagles (Savarie et al. 1979). An NOEL was not determined by Savarie *et al*.
7 Values based on those of adult pueo and adjusted for juvenile weight

diphacinone and chlorophacinone would be about 2.52 g / plot. An undetermined, portion of the pellets are expected to be deposited in crevices in the soil and cracked lava substrate, out of reach of most non-target species, yet still accessible to house mice. Therefore, not all pellets would be available to all non-target species. Moreover, house mice are expected to quickly begin consuming and caching bait, further reducing the quantity of bait available to non-target species.

A risk analysis for broadcast use of chloraphacinone in Hawai'i comparable to that for diphacinone presented in Tables 1 and 2 is not available. However, available data indicate both chemicals have similar toxicity to rodents and that birds are considerably more sensitive to chlorophacinone than to diphacinone (Table 3). These data were used to create a conversion factor of 6.3 to compare the sensitivity birds and mammals to chlorophacinone relative to diphacinone, i.e., birds and mammals are about 6 times more sensitive to chlorophacinone than diphacinone. Although, a factor of 6 will be used for calculating poisoning risk of chlorophacinone, this may inflate the actual risk from secondary poisoning based on data in Erickson and Urban (2004, Tables 14 and 15).

Table 3. Acute oral and dietary toxicity of chlorophacinone and diphacinone to birds and Norway rats. LD50 represents mg/kg of body weight and LC50 represents mg/kg in diet.

Species	Rodenticide	LD50 mg/kg (95% CI)	LC50 mg/kg/day (95% CI)	Reference
N bobwhite quail	Chlorophacinone	258 (167-356)	56 (22-105)	(Erickson and Urban 2004)
	Diphacinone	400 <LD50<2000	>5000	
Mallard duck	Chlorophacinone		172 (75-498)	
	Diphacinone		906 (187-35,107)	
Norway rat	Chlorophacinone	6.26 (4.68-8.3)	1.14 (0.98-1.35)	(Anderson et al. 2011)
	Diphacinone	1.9 (1.4-2.3)	2.08 (1.57-2.76)	

ENVIRONMENTAL CONSEQUENCES

For the purposes of this EA, “effect” is synonymous with “consequences” and “impact,” and effects may be positive or negative.

Alternative A - No Action

Taking no action would result in no impacts to physical characteristics, wetlands and water resources, recreation, cultural resources, or human health and safety. Under the no action alternative, house mice numbers would not be reduced in the affected area, which may result in some predation on listed plants and native invertebrates. Similarly, not reducing house mice numbers may result in predation on eggs of gamebirds. Taking no action would also obviate any primary and secondary poisoning to non-target species, including native and non-native birds and introduced mammals. Furthermore, under the no action alternative valuable data would not be collected that would inform efforts to implement the Integrated Pest Management Plan for mouse control and eradication efforts in the State of Hawai’i.

Alternative B - Trial with both diphacinone and chlorophacinone (Proposed/Preferred Action)

Physical Characteristics

The physical characteristics of the affected area would not change with the implementation of the proposed alternative.

Biological / Ecological Resources

Vertebrates Listed under the Endangered Species Act

The palila, ‘alalā, ‘ākepa, Hawai’i creeper, and ‘akiapōlā‘au have not been observed on PTA for almost 30 years. Similarly, the ‘i‘iwi is considered rare on PTA and has not been recorded on annual bird surveys since 1992 (Schnell 2017). The data indicate that these six species are not present in the affected area; therefore, these six species are not at risk from the proposed action.

Data from annual avian monitoring conducted by PTA contractors between 2006 through 2015 will be used to estimate nēnē abundance and distribution in the affected area. These data will be supplemented with information gathered by PTA contractors while they are conducting their daily activities in the affected area. These same data will be used to estimate the diversity, abundance, and distribution of birds protected under the MBTA and Hawai'i State Game laws that may be at risk of impact from the proposed action. Surveys were conducted on 15 transects, but four of these will be omitted from further analysis. Those omitted are relatively close to the developed areas on the base and encompass habitats that are not representative of the affected area. The remaining 11 transects are all within 8 km of the affected area, with one crossing proposed treatment plots (Fig. 4). On these transects there were 204 survey

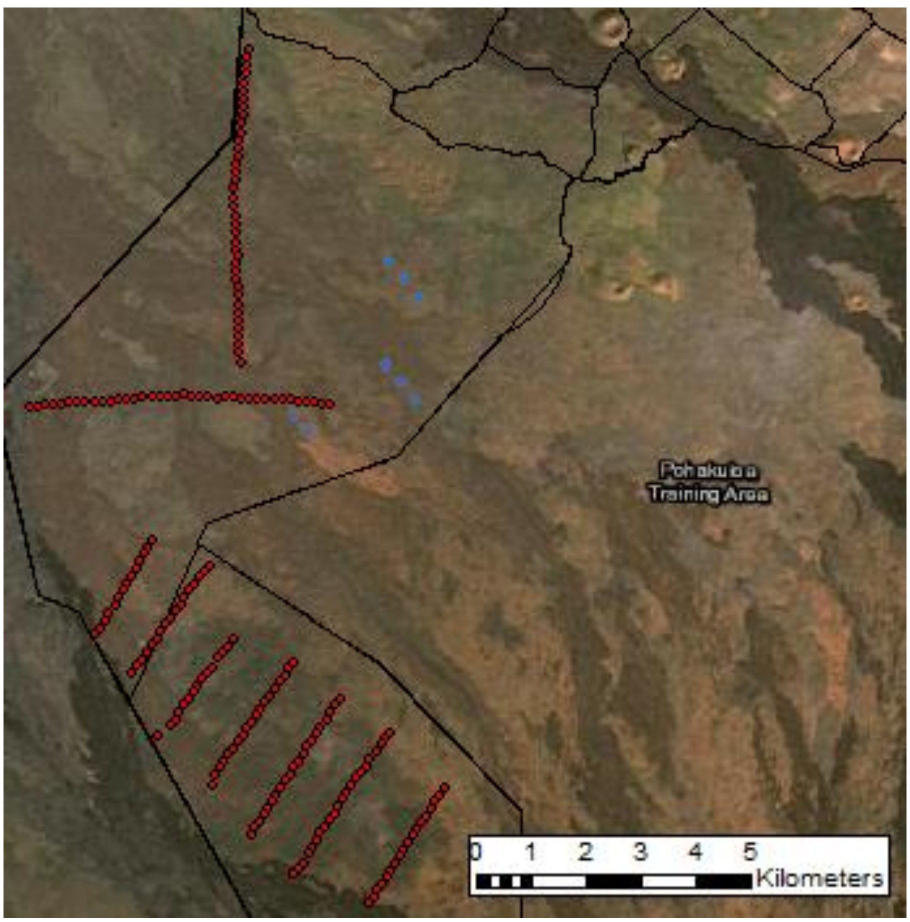

Figure 4. Eleven transects used to assess diversity and abundance of birds on PTA. Note, the four northernmost transects are configured such that two transects run continuously.

points, which translates into 2,040 survey points over the ten year period. Transects were surveyed once per year between mid-December and early January.

Hawaiian hawk (ʻio) – The Hawaiian hawk or ʻio is considered such an infrequent visitor to PTA that the Service in its 2013 Biological Opinion (USFWS 2013a) acknowledged "receipt of a no effect determination for this species for all anticipated military training at PTA on January 4, 2013. Consequently, Army environmental personnel are no longer required to survey for that species as specified in the 2003 Biological Opinion (USFWS 2003)." Because ʻio are not expected to be in the area, ʻio would not be affected by the proposed action.

Hawaiian hoary bat (ʻōpeʻapeʻa) – While the Hawaiian hoary bat is ubiquitous on PTA, the Service determined in an informal consultation (USFWS 2014) with the Hawai'i Department of Agriculture, Pesticides Branch that bats could forage in areas where rodenticide is used, but "the likelihood that bats will ingest sufficient numbers of potentially contaminated insects to accumulate a dose at which effects could occur is extremely low." Because bats are extremely unlikely to consume enough insects intoxicated by rodenticide to cause lethal or sublethal effects, no bats would be affected by the proposed action.

Petrels (ʻuaʻu and ʻakēʻakē) – The Hawaiian petrel (ʻuaʻu) and band-rumped storm petrel (ʻakēʻakē) are recorded from PTA. Petrels, and seabirds in general, are considered to be at low risk of primary exposure from rodenticide baits they might encounter on land because they feed at sea, are predatory, prefer live fish, and are not likely to be attracted to baits on the ground. Seabird chicks are at a slightly greater risk of ingesting rodenticide baits than adults. Chicks are curious and will pick up rocks, sticks and other objects they find on the ground near their nests (Finkelstein et al. 2003). However, Hawaiian petrels are not known to nest on PTA and the closest known band-rumped storm petrel colony is about 15 km from the affected area, obviating any risk to these two species. Therefore, no petrels of either species would be affected by the proposed action.

Hawaiian goose (nēnē) – The affected area is not used for nēnē breeding activity and appears to have little importance for foraging. On the above-mentioned transects and during daily field activities since 2007, fewer than ten nēnē have been observed on the ground within 10 km of the affected area. The relative abundance and distribution of a species in the affected area influences the likelihood of it being impacted by the proposed action. Because of the infrequent use of the affected area by nēnē, the proposed action would be unlikely to affect any birds.

Birds Protected by the MBTA that are not listed under the ESA

Along the 11 transects included in the analysis, eight species of birds protected by the MBTA were detected and their relative abundances varied considerably. ʻAmakihi were the most numerous, with 9,115 individuals detected, 1,659 house finch, 496 ʻapapane, 231 northern mockingbird, 49 northern cardinal, 4 kōlea, 3 pueo, and 1 ʻōmaʻo. While relative abundance is important, the distribution of the species across the survey transects is informative. ʻamakihi were detected along 1,894 of the 2040 survey points, house finch on 722, ʻapapane on 268, northern mockingbird on 183, northern cardinal on 44, kōlea on 4, and pueo on 3. The relative abundance and distribution of a species in the affected area influences the likelihood of it being affected by the proposed action; therefore, given the very low abundance and patchy distribution of ʻōmaʻo in the affected area, it is unlikely any birds of this species would be affected by the proposed action.

ʻApapane and ʻAmakihi – While very abundant, ʻapapane and ʻamakihi are at extremely low risk of impact from the proposed action due to their diet and foraging behavior. They feed on nectar, and foliar insects and spiders, and forage primarily in the mid- to upper strata of the forest canopy (Fancy and Ralph 1997). Despite their high numbers, ʻamakihi are also at relatively low risk due to their diet. They feed mostly on insects and other arthropods, nectar, fruit, and sap (Lindsey et al. 1998). Some of the invertebrate taxa that ʻamakihi consume could potentially eat rodenticide baits; however, the bird mostly gleans insects from trees, ferns, and shorter plants. Therefore, it is unlikely ʻapapane or ʻamakihi would be affected by the proposed action.

Northern cardinals – Cardinals eat a wide range of seeds, fruits, and invertebrates (Halkin et al. 1999), indicating they would likely consume the rodenticide baits or the invertebrates feeding on the baits if available. However, observations of cardinals have been declining in recent years. From 2011 through 2015, only 12 birds were observed, one in 2013 and two in 2014, and all of these 12 birds were detected greater than 2 km from the affected area. Mean home ranges of cardinals in Tennessee and Ontario varied 1.18±0.16 ha and 18.81±1.138 ha, respectively (Dow 1969). Length of ranges varied between 167.1±10.48 m and 731.9±39.95 m, respectively. Based on the lack of recent observations on transects near the affected area and cardinal movement patterns it appears the likelihood of northern cardinals being affected by the proposed action is very low and only 0 to 1 birds are likely to be killed or sublethally-affected by the proposed action. Because so few birds would be affected, population level effects are highly unlikely.

Northern mockingbirds and house finches – It is possible that incidental impacts to northern mockingbirds and house finches would result from the proposed action. Both species are consistently observed across the affected area and the diet and foraging behavior of each make it likely they would ingest rodenticide. House finches primarily eat vegetation, much of their diet consisting of seeds (Badyaev et al. 2012); hence, they could eat the grain-based pellet-shaped baits. A 22 g house finch would need to eat about seven diphacinone pellets per day over multiple days (e.g., 5 days) to ingest a LLD, based on data presented in Table 2. To receive a sublethal dose, that same bird would need to eat about 30% of a pellet per day over multiple days. Corresponding values for chlorophacinone are 50% and 2%, respectively. Although, house finch home range data are not available, they are for white-crowned sparrow (Baker and Mewaldt 1979), a passerine of similar size and diet (Chilton et al. 1995; Badyaev et al. 2012). White-crowned sparrow average home ranges in California were 6.2-6.7 ha (Baker and Mewaldt 1979). Across the 11 transects, detection of house finch averaged 1.23 birds per survey point and ranged from 0 to 11. Based on these data 20 to 40 house finches might be exposed to a lethal dose, or sublethally-affected by the proposed action. House finches were relatively abundant, with 1,659 observed during surveys. This indicates the species is common on PTA and that killing or sublethally-affecting 20 to 40 birds would be unlikely to lead to population level effects.

Mockingbirds are omnivorous, eating primarily arthropods and fruits, occasionally taking small lizards (Farnsworth et al. 2011), so primary poisoning is not a risk. However, secondary poisoning is a risk and a 48 g bird would need to eat about 22, 1.0 g invertebrates that had ingested diphacinone each day over multiple days to receive the LLD. To receive a sublethal dose of diphacinone that same bird would need to eat about one, 1.0 g invertebrate each day for multiple days. Corresponding values for chlorophacinone are about 3.5 and 0.2 grams of invertebrates, respectively. Average maximum home ranges of mockingbird were 7.6-7.9 ha (New Jersey; Utter 1971 in Biedenweg 1983) and 6.5 ha (California; Biedenweg 1983). On the 11 transects, mockingbird detection rates averaged 0.11 birds per survey point and ranged from 0 to 4. Based on these data, 1 to 5 mockingbirds may be killed or sublethally-affected by the proposed action. Removing 1 to 5 mockingbirds from the area will not cause population-level effects because these birds are relatively abundant.

Although, the surveys conducted on PTA indicate pueo and kōlea are only slightly more abundant than ʻōmaʻo, a more conservative approach and analysis is being taken for these two MBTA-protected birds.

Pueo - While only 3 pueo were detected over the 10-year monitoring period, this effects analysis is conducted under the assumption that 4 breeding pairs of pueo, each with 3 young per pair, would be present in the affected area during the study period.

Baseline studies on pueo biology have not been conducted, resulting in an almost complete absence of biological data for the subspecies. The data available for pueo are mostly anecdotal; therefore data on short-eared owls (*Asio flammeus spp.*) from other locations were used for this analysis, unless otherwise noted. Adult female short-eared owls are larger than males, 392.5 g vs 304.0 g (mean = 348.3 g), respectively (Clark 1975). DeGroot (1991b in De Groot 1983) measured 3 male and 3 female Galapagos owls (*A. f. galapagoensis*) and reported a mean body weight of 343 g. Both values correspond to the 350 g used in Eisemann and Swift (2006), which were used in this analysis. A weight of 190 g for short-eared owl chicks was used and is based on data from Clark (1975, Fig. 8, p. 49). A territory size of 242 ha was used for each breeding pair and is based on the largest reported territory (Village 1987). While short-eared owl territories vary considerably (Lockie 1955; Clark 1975; Village 1987), this larger size is appropriate given the few sightings and apparent poor habitat. Short-eared owls are territorial under most conditions and defend boundaries vigorously (Lockie 1955; Clark 1975; Village 1987).

In North America, the first brood may occur from mid-March through June (Wiggins et al. 1993); however, in the Galapagos nests with eggs were found in all months except June, July, August, and October (De Groot 1983). Breeding data from the Galapagos may better approximate the situation in Hawai'i, given both archipelagos experience little seasonal variation in temperature and distinct wet and dry seasons, and therefore were used in the analysis. Short-eared owls exhibit pre-fledging where they leave the nest prior to independence (Clark 1975; Holt et al. 1992, and references therein). Young often leave the nest around 2 weeks of age, remaining near the nest and fed by the parents, then fledging (i.e., attaining flight capability) around day 30. In the Galapagos, young were dependent on parents almost 2 months post-hatch (De Groot 1983). Second broods appear to be uncommon (Wiggins et al. 1993). During incubation males usually provision females (Clark 1975; pp. 48-49 Incubation).

Short-eared owls will hunt during all periods of the day, but the relative importance of diurnal, crepuscular, and nocturnal periods varies (Clark 1975; De Groot 1983; Village 1987; Wiggins et al. 1993). In the Galapagos, short-eared owl hunting activity appears to be associated with the presence or absence of sympatric raptors (Galapagos hawk, *Buteo galapagoensis* and Barn owl, *Tyto alba*)(De Groot 1983). In the presence of just the diurnal hawk, short-eared owls are strictly nocturnal. When sympatric with just the barn owl, which is largely nocturnal, short-eared owls are both diurnal and nocturnal. In the absence of both the hawk and the barn owl, short-eared owls appear to be crepuscular. Pueo are considered to be diurnal and crepuscular, foraging up to one hour after sunset (DLNR 2005; USFWS 2013b).

The diet of short-eared owls is comprised primarily of small mammals, but can include birds, reptiles, and invertebrates, and this will vary considerably with region (Lockie 1955; Clark 1975; Village 1987; Wiggins et al. 1993). In island or coastal areas, short-eared owls are reported to prey more heavily on birds (Clark 1975 and references therein, p. 29). In one study in Point Reyes, CA, 50% of the diet of short-eared owls diet was comprised of birds (Page and Whitacre 1975). Similarly, in the Galapagos 51% of the biomass in the diet of the short-eared owl was comprised of birds, with 47.1 % being small mammals (De Groot 1983).

Several studies have examined the number of rodents consumed by various species of owls, including short-eared owls, in the wild and captivity. Captive data were evaluated here (Graber 1962; Marti 1973), but not used because it is accepted that daily caloric intake of captive owls underestimates that of wild owls (Wiggins et al. 1993). Wild adult short-eared owls were found to consume on average between 50 to 58 g of rodent / day (Lockie 1955; Graber 1962; Korpimaki and Norrdahl 1991). For short-eared owl chicks, two studies found consumption ranged from 40 to 63 g of rodent / day (Lockie 1955; Korpimaki and Norrdahl 1991); however, in another study the daily intake of a single captive-reared short-eared owl chick averaged 78 g of rodent (Clark 1975).

Assessing the risk to pueo also requires evaluating the potential quantity of rodent biomass on the proposed study plots. Average body size of mice on the study plots is estimated to be 12 g (Foster 2016). House mouse density varies seasonally, ranging from very low numbers to irruption levels, with average density on the study plots estimated at 50 mice / ha (Niebuhr 2017). House mice are primarily nocturnal (Mackintosh 1981; Potter 1994; Timm 1994; Latham and Mason 2004). It is likely black rats would also be present on the proposed study plots, but their density is expected to be much lower than that of house mice (Schnell et al. 1998; Shiels et al. 2014 and references therein), with an estimated 5 rats / ha. Rat body sizes vary considerably, but will be estimated at a mean of 90 g (Tamarin and Malecha 1971; males = 103.8 g, females = 75.4 g). Similar to mice, rats are primarily nocturnal, with activity beginning immediately after dark (Lindsey and Mosher 1994).

To calculate exposure risk to pueo several conservative assumptions were made, including some “worst case scenarios.” One such scenario has each pueo territory overlaying at least one study plot. Using 242 ha as a territory size for each pueo pair, coupled with no overlap of territories, yields a configuration where two breeding pair have three study plots within their territory, one pair has two plots, and another has a single plot (Fig. 5). For this scenario, the territory with the single plot would have rodenticide applied to the plot. This translates into two breeding pueo pairs having rodenticide applied to 2.07% (5 ha) of their territories each and two pairs having rodenticide applied to 1.03 % (2.5 ha) (See Alternative B in Action Alternatives above for application of diphacinone and chlorophacinone). Because of the general nature of this model, and no data to suggest otherwise, pueo will be considered to randomly forage across their territories. Study plots with intoxicated rodents are not expected to attract pueo to the area. Furthermore, field studies in Hawai’i examining the behavior of rodents that consumed rodenticide during control operations determined that the majority of intoxicated rodents die

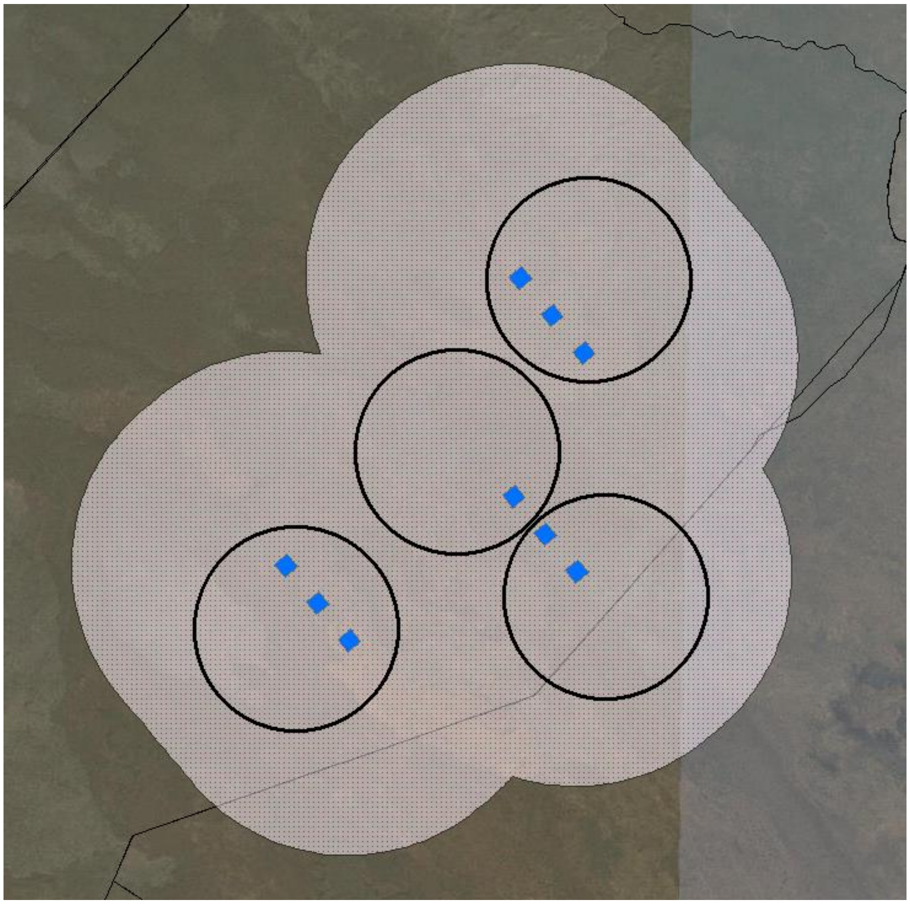

Figure 5. Hypothetical “worst case” distribution of four pueo pair, 242 hectare territories (black circles) overlaying the proposed study plots (blue squares). The stippled area is a buffer zone established using the diameter (1,755 m) of the pueo territories from the outside edge of the study plots. This representation is a worst case scenario, where all study plots are within a pueo territory.

in areas inaccessible to avian predators (Lindsey and Mosher 1994, 7 of 7 radio-collared rats; Spurr et al. 2003, 20 of 21 radio-collared rats).Furthermore, Lindsey and Mosher (1994) placed 43 rat carcasses on the Hakalau Forest National Wildlife Refuge, in an area where ‘io were present and none of the carcasses were approached by the hawk. Additionally, NWRC will collect any rodent carcasses found during opportunistic searches, reducing the likelihood that pueo will encounter a carcass. In this scenario, pueo will also be considered to forage exclusively on rodents, despite evidence to indicate birds could comprise a large component of their diet, which inflates exposure probabilities. In contrast to the rodents, the majority of birds on the plots would pose no secondary poisoning risk to pueo: the most abundant passerine (‘amakihi) is unlikely to ingest rodenticide and the most abundant game bird (Erkel’s francolin), which could ingest rodenticide, is unlikely to be preyed upon by pueo due to its large size (1.2 kg).

Based on bioenergetics studies on short-eared owls, an adult pueo needs 58 g of rodent (e.g., mouse) tissue per day to meet its energetic needs, which translates to 4.8 mice per day. A nestling pueo needs around 72 g of rodent tissue per day to meet its energetic needs, which translates to 6 house mice per day. House mice are used instead of rats, because they are more abundant than rats and have a greater probability of being preyed upon. Table 4 presents the number of highly-intoxicated mice (at the highest values recorded in animal tissues) adult and nestling pueo would need to consume to receive the lowest lethal dose or a sub-lethal dose (also see Tables 2 and 3).

The above data indicate it would be highly unlikely for an adult pueo to receive a lethal dose from diphacinone intoxicated rodents, because it would need to consume more than its daily

Table 4. Number of mice intoxicated with rodenticide (diphacinone and chlorophacinone) and grams of rodent tissue necessary for a pueo to consume the lowest lethal dose (LLD) or sub-lethal dose (LOEL). Values in parenthesis are grams of mice.

	Adult		Nestling	
	LLD-No. mice / day (g)	LOEL-No. mice / day (g)	LLD -No. mice / day (g)	LOEL-No. mice / day (g)
Diphacinone	7.1 (85.5)	1.0 (12.5)	3.9 (46.4)	0.6 (6.8)
Chlorphacinone	1.0 (12.5)	0.2 (2.0)	0.6 (7.5)	0.1 (1.1)

energetic needs, and do so for multiple consecutive days. To assess the risks of the other combinations (i.e., two rodenticides and two pueo age classes), it is necessary to examine the probability of exposure to intoxicated rodents. On the pueo territories with one rodenticide plot, rodenticide would be applied to 2.5 ha within a 242 ha territory. Therefore, assuming an equal hunting effort across its territory, the probability a pueo would encounter, capture and consume (or provision) an intoxicated mouse from a diphacinone or chlorophacinone plot from a single foraging bout would be 1 in 96.8 or 1.03% ([2.5 ha / 242 ha] * 100). Because each foraging bout would be an independent event, on territories with a single rodenticide plot the probability that a pueo would capture two mice in the same day, or one mouse on two consecutive days, would be 0.01%. For three mice or three days, the probability would be 0.0001%, etc. On territories with two rodenticide plots where rodenticide would be applied to 5 ha within a 242 ha territory, the probability would be 1 in 48.5 or 2.07% ([5 ha / 242 ha] * 100). Therefore, the probabilities for two and three mouse encounters translate into 0.04% and 0.0009%, respectively.

It should be re-emphasized that diphacinone and chlorophacinone are first-generation anticoagulant rodenticides, requiring multiple feedings over several days, and the sensitivity of birds and mammals to large single doses is extremely low (e.g., nestling pueo >18,241 g diphacinone; >3,919 g chlorphacinone) (see Table 2; LD_{50} Secondary Exposure). Because of this low sensitivity to large doses, substituting rats for mice in the scenario is unlikely to increase the risk calculations, and may in fact decrease the odds of encounter since rats are less abundant in the environment.

Based on the above scenario, which makes several conservative assumptions, it is highly unlikely that any pueo would be affected by the proposed action. However, because of the remote possibility that two adult and three fledgling pueo could experience sublethal effects from the proposed project, an MBTA permit to cover this level of take will be obtained to ensure there would be no violation of the MBTA in the highly unlikely event take did occur. Take of these few birds, however unlikely, would not have population-level effects on pueo.

Kōlea – Only four kōlea have been detected in 10 years of avian monitoring on the 11 transects, which indicates that kōlea are uncommon in and around the affected area. Nonetheless, to be conservative, it was assumed that four birds could occur in the affected area during at least part of the time the treatments take place, and thus potentially be exposed to rodenticide.

Kōlea do not breed in Hawai'i. The vast majority of individuals depart the islands for Alaska in late April and return in mid-August (Johnson et al. 1989; Johnson et al. 2001). In one study, covering two years, all of the 115 radio-tagged birds departed Hawai'i for their summer breeding grounds (Johnson et al. 2004).

Winter territories in Hawai'i are usually on artificial habitats (e.g., lawns and golf courses). In high-quality habitats such as these, territories on Oahu range from about 0.05 to 0.4 ha (Johnson et al. 2001). These territory sizes are comparable with other *Pluvialis* species (Colwell 2000). The four sightings of kōlea in the affected area during the annual avian monitoring likely represent dispersing juveniles and not territorial birds (Bruner 2017). Kōlea in their first winter on Hawai'i seek good habitat in which to establish a territory, if successful, the bird is likely to return each winter. Given the scattered nature of the observations of kōlea on the 11 annual transects on PTA it is assumed that these sightings represent dispersing juvenile birds that do not have territories. This premise is supported by the annual avian monitoring data from the four transects omitted from our analysis. As noted above, those four transects were omitted because they are near the northeast boundary of PTA in developed habitats uncharacteristic of the rest of the PTA. On these four transects alone there have been 58 kōlea detected during the same 10-year period.

In light of these data, this analysis will be conducted under the assumption that each kōlea in the affected area occupies a space encompassing 400 ha, and treat this as a hypothetical territory. This occupied area is much smaller than the winter home range of some plover species (e.g., HR = 12.6 km^2, core area = 2.9 km^2; piping plover, *Charadrius melodus*)(Drake et al. 2001). As with the pueo analysis, a worst case scenario will be assumed, with each territory overlaying rodenticide plots and no overlap of territories (Fig 6).

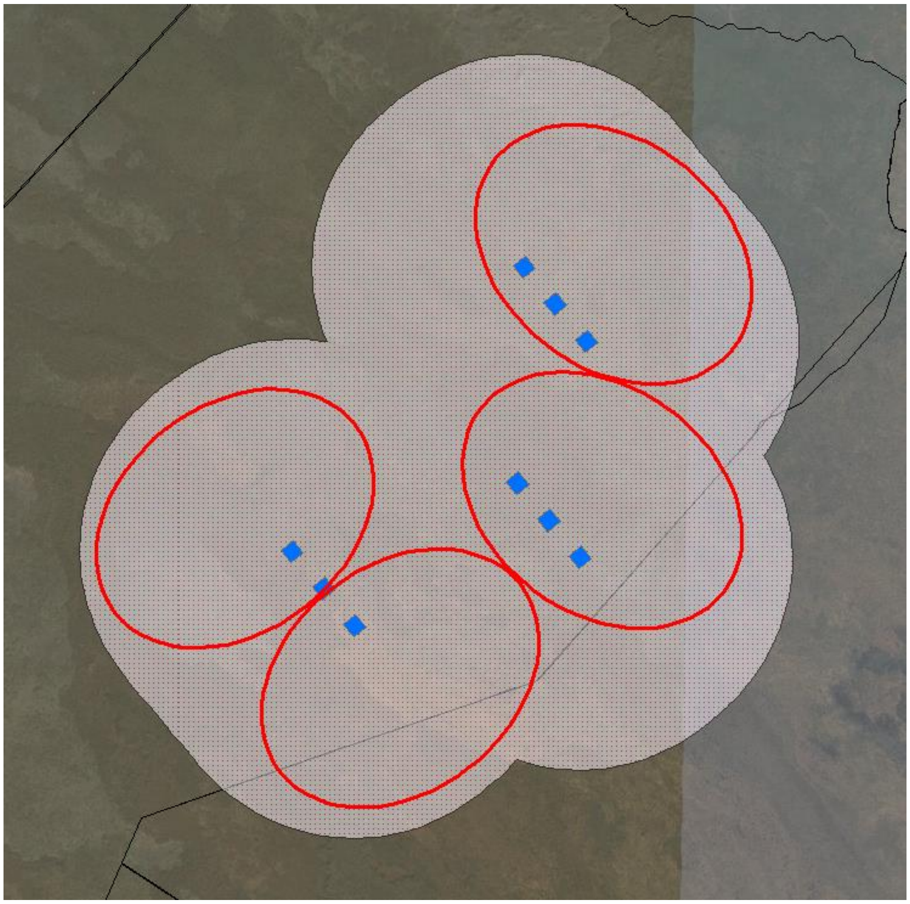

Figure 6. Distribution of four kōlea 400 hectare territories (red ellipses circles) overlaying the proposed study plots (blue squares). The stippled area is a buffer zone established for the pueo territories (see Fig. 5). This representation is a worst case scenario, where all study plots are within a kōlea territory.

On Oahu, mean body weight of kōlea ranges from 118 and 171 g (Johnson and Connors 2010). This translates to an overall mean of 144.5 g, which will be used for the analysis. Kōlea are omnivorous and opportunistic in their food habits (Johnson and Connors 2010, and references therein). Invertebrates comprise the principle component of their diet, but berries are seasonally important, and in some situations kōlea are known to consume human scraps (e.g., bread, rice). Because of this catholic diet, kōlea are potentially at risk from both primary (i.e., consuming rodenticide baits) and secondary (i.e., consuming invertebrates that have eaten rodenticide) poisoning; however, consumption of invertebrates that have fed on rodenticide pellets poses the greatest risk to the birds.

Data on daily food consumption of kōlea are unavailable, but the black-bellied or grey plover (*P. squatarola*) was found to eat an average 23.6 g of food / day (Kersten and Piersma 1987). This was in the laboratory with air temperatures from 25 to 61°F (see Affected Environment, Physical Characteristics section). Because grey plovers are considerably heavier than kōlea, averaging 270 g during the winter (Serra et al. 2006) a correction in daily food consumption is necessary. Kōlea weigh about 53% of grey plovers, therefore their expected daily food consumption would be around 12.6 g. As noted for pueo, energetic requirements of wild birds are likely higher than those in captivity (Wiggins et al. 1993)

Kōlea depart nocturnal roosts and arrive on feeding grounds before dawn, where they remain until around sunset (Johnson et al. 1981). The majority of daylight hours (68%) are spent foraging (Phillip Bruner, pers. comm. in Johnson and Connors 2010). In contrast to the pueo scenario, invertebrates feeding on rodenticide would likely be apparent during the day and has the potential to function as an attractant to foraging kōlea.

Based on the above data, it appears likely that 2 kōlea could be present during the proposed study period and that these 2 kōlea, in the in whose territory rodenticide would be applied, could feed on invertebrates feeding on the pellets. It is highly unlikely that a kōlea could consume a sufficient quantity of intoxicated invertebrates each day over multiple days to receive a lethal dose of either rodenticide (64.22 g of prey with diphacinone; 10.16 g of prey with chlorophacinone). However, in this worst case scenario, 2 kōlea may be sublethally affected from consumption of intoxicated invertebrates. It is unlikely that sublethally affecting 2 kōlea in the study area would cause population level effects, because these kōlea are abundant in Hawai'i and across the Pacific.

Game birds

Of the 13 game birds found on PTA, eight have been recorded on annual surveys of the 11 transects between 2006 through 2015 (Fig. 4). Erckel's francolin was the most abundant with 807 individuals detected, 152 California quail, 109 black francolin, 48 kalij pheasant, 37 chukar, 4 grey francolin, 2 wild turkey, and 1 Japanese quail. The number of survey points where these species were recorded are: Erckel's francolin 446, California quail 89, black francolin 66, kalij pheasant 26, chukar 24, grey francolin 3, and wild turkey 2. As with some MBTA-protected birds, grey francolin, wild turkey, and Japanese quail are at such low abundance and patchily distributed in the affected area that no birds would be affected by the proposed action.

Of the five remaining game birds detected in the affected area, all would be at some risk of being affected by the proposed action and that risk would vary with their relative abundance and distribution, in combination with their diet and body size. Body sizes vary considerably with gender and geographic location of a species; however, representative sizes for these five are: California quail 0.17 kg, black francolin 0.45 kg, chukar 0.60 kg, kalij pheasant 0.90 kg, and Erckel's francolin 1.2 kg (Bump and Bohl 1961; Christensen 1996; Islam 1999a; Islam 1999b; Calkins et al. 2014). The diet of each of these species is comprised primarily of vegetation (e.g., seeds and fruits) and animal matter (e.g., insects and snails), which puts them at risk of both primary and secondary poisoning. Table 4 presents the quantities of bait or invertebrates the above game birds would need to eat to receive a minimum lethal or sublethal dose. Calculations are derived using data from Eisemann and Swift (2006, including modifications noted in Table 2) and comparative toxicity data on chlorophacinone and diphacinone (Erickson and Urban 2004; Anderson et al. 2011).

Table 4. Amount of diphacinone and chlorophacinone rodenticide bait and invertebrates that fed on bait five species of game birds would need to consume to receive a LLD (lowest lethal dose) or sublethal dose. CAQU=California quail; BLFR=black francolin; CHUK=chukar; KAPH=kalij pheasant; ERFR=Erckel's francolin.

	Diphacinone[1]				Chlorophacinone[2]			
	Primary		Secondary		Primary		Secondary	
Game bird	LLD (g bait)	LOEL (g bait)	LLD (g invert)	LOEL (g invert)	LLD (g bait)	LOEL (g bait)	LLD (g invert)	LOEL (g invert)
CAQU	7.8	0.4	78.0	3.7	1.2	0.06	12.3	0.6
BLFR	20.7	1.0	206.4	9.9	3.3	0.1	32.7	1.6
CHUK	27.6	1.3	275.2	13.2	4.4	0.2	43.6	2.1
KAPH	41.4	2.0	412.9	19.8	6.6	0.3	65.3	3.1
ERFR	55.2	2.6	550.5	26.4	8.7	0.4	87.1	4.2

1 Average weight of one diphacinone pellet is about 0.15 g

2 Average weight of one chlorophacinone pellet is about 0.31 g

Based on the toxicity data and the relative numbers and distribution of chukar and kalij pheasant it is likely that 3 to 6 birds of each species would be killed or sublethally affected by the proposed action. In addition, four to 8 Erckel's and black francolin, each, are likely to be killed or sublethally affected by the proposed action. Black francolins are at a greater risk due to their small size, whereas the larger Erckel's is much more numerous. The relatively high number of California quail, combined with their covey forming behavior elevates their risk from the proposed project. Up to 20 birds were detected at a single survey point. It is anticipated that 20 to 30 California quail are likely to be killed or sublethally affected by the proposed action. However, it is unlikely that removing 3 to 6 chukar and kalij pheasants (each), four to 8 black and Erckel's francolins, and 20 to 30 California quail from the area would not cause population level effects, because these birds are relatively abundant.

State protected, non-game birds

Of the 12 species of non-game, native, and non-native birds on PTA that are State-protected, only two occur at population levels where effects from the proposed action need to be considered. These species are: African silverbill and yellow-fronted canary. Silverbills were recorded 774 times at 287 stations and canaries were recorded 987 times at 492 stations. Both species are granivorous, therefore primary poisoning is a risk. The two birds are of similar size, with canaries averaging 12.8 g and silverbills 10.0g.(Animal Diversity Web 2016; FinchInfo 2016). An individual of each species would need to consume 3 to 4 pellets of diphacinone per day to receive a lethal dose and about 0.15% of a pellet to receive a sublethal dose. Corresponding values for chlorophacinone would be 0.3% and 0.01%. Because of their relatively high abundance and small body size between 25 to 50 individuals, each, of the two species are likely to be killed or sublethally affected by the proposed project. However, it is unlikely that removing 25 to 50 African silverbills and 25 to 50 yellow-fronted canaries from the area would cause population level effects because these birds are relatively abundant.

Vertebrates Without Protected Status

Ungulates have been suppressed to such a low number in the affected area that no animals would be affected by the proposed action.

Feral dogs, feral cats, and mongooses would be expected to occur in the study area, but estimates of their population sizes are unknown. These three species are predators of rodents and would be expected to scavenge or prey on dead or dying mice, if available, and an unknown number are likely to be killed or sublethally affected by the proposed project. However, because of the small size of the study plots relative to the larger home ranges of these predators there would be no population level effects on dogs, cats, or mongooses from the proposed project.

Black rats are expected to occur in the affected area, but at much lower density than house mice (Schnell et al. 1998; Shiels et al. 2014). Rats would be expected to consume the rodenticide bait and an unknown number are likely to be killed or sublethally affected by the proposed project. However, because rats are extremely abundant and widespread there would be no population level effects on rats from the proposed project.

It should be noted, feral dogs, feral cats, mongooses, and black rats all impact native Hawaiian species and are considered pest species.

Japanese white-eye – It is likely that incidental impacts to Japanese white-eyes would result from the proposed action. White-eyes are very common in the affected area with 1170 detections during the 10-year survey. Their diet consists of insects, fruit, and nectar (Van Riper and Guest 2000), with approximately 90% comprised of small arthropods measuring <2mm (Kawakami and Higuchi 2003). Primary poisoning is not a risk, but secondary poisoning is and a 11 g bird (Guest 1973) would need about five, 1.0 g invertebrates that had ingested diphacinone each day over multiple days to receive the LLD. To receive a sublethal dose of diphacinone that same bird would need to eat about 0.2 g of invertebrate each day for multiple days. Corresponding values for chlorophacinone are less than 0.8 and 0.04 grams of invertebrates, respectively. The bird uses all substrates in its forest habitat, but appears to avoid foraging on the ground, using this space about 2% of the time (Kawakami and Higuchi 2003). Detections occurred at all stations and a maximum of 5 birds were detected at a single station. White-eye breeding pairs occupied territory averaging 1.6 ha in Oahu (Guest 1973). On the 11 transects, detections of white-eyes ranged from 0 to 5. Based on these data, 12 to 18 Japanese white-eyes are likely to killed or sublethally affected by the proposed action. It is unlikely that removing 12 to 18 white-eyes from the area would cause population level effects, because these birds are relatively abundant. Additionally, white-eyes are considered “injurious” species by the state of Hawai’i.

Invertebrates With Protected Status

Aside from the single yellow-faced bee (*Hylaeus anthracinus*) collected between 1999 and 2002 no other listed species of invertebrates are known to occur in the affected area (Magnacca 2007; U.S. Army Garrison 2010; PIFWO 2016). Subsequent surveys for yellow-faced bees found none on PTA (Magnacca and King 2013). Because of the absence of listed species on PTA since 2002, no effects from the proposed action would occur.

Plants listed under the Endangered Species Act

Of the 20 species of federally listed plants know to occur on PTA, four species (*Festuca hawaiiensis*, *Kadua coriacea*, *Stenogyne angustifolia*, and *Zanthoxylum hawaiiense*), representing ten individuals are found within 50 m of the affected area (The distance of 50 m was used as a buffer because it is assumed that the only potential impact to plants from the proposed study would be from trampling). In between two of the proposed plots, five individuals of listed plants occur, including creeping mint. These plants would be at risk from trampling as field staff travel over and between plots. PTA contractors would mark the locations of these plants, as well as educate project staff on the location and identification of these listed species, which would obviate any effects from the proposed project.

Summary of Effect to Biological Resources

Anticipated effects to MBTA-protected birds and game birds from primary and secondary poisoning may be offset in part from the reduction in predation from invasive predators that are affected by the proposed project. Similarly, the proposed action may briefly reduce predation on listed plants.

Wetlands and Water Resources

No wetlands occur on or near the study site, thus there would be no change with the implementation of either alternative. Impacts to downstream water resources are unlikely to occur. There are no downslope perennial streams and the closest is approximately 9 km from the affected area. Furthermore, both chlorophacinone and diphacinone are expected to bind very tightly with soil (US EPA 1998). Most of the chemical is expected to remain in the top soil layers, and its potential to reach ground water is very low. Surface water contamination, although unlikely, may occur in less-permeable areas and in areas near water bodies. The mechanism for the chemical to reach surface waters would likely be via adsorption to eroding soil, as opposed to dissolution in runoff water. In the event of reaching surface water, both chlorophacinone and diphacinone would be expected to be partitioned into the suspended and bottom sediments instead of the water column.

Recreation

The study plots are located within fenced units that are closed to public access and hunting, therefore recreation activities in the affected area would not change with the implementation of the proposed action.

Human Health and Safety

Implementation of the proposed alternative is not expected to affect field personnel. Staff would be supervised by Certified Applicators and required to wear appropriate personal protective equipment as prescribed on the rodenticide labels when applying bait.

While game mammals (e.g., feral pigs) may eat rodenticide baits, public access to the affected area is closed and game mammals have been almost completely removed from the treatment area, so there would be no the risk of hunters consuming poisoned game mammals. Game birds may consume rodenticide baits on the affected area, but the proposed action, planned for June through September 2017, does not coincide with the main game bird season, which runs annually from early November through January. Furthermore, it is unlikely birds would move into areas accessed by hunters. The closest hunting unit to the proposed study site is the Pu'u Anahulu Game Management Unit (GMA), about 2.9 km (1.7 mi.) distant, which is outside of the normal movements of the most common game birds species in the affected area. However, bait could be expected to remain available on the ground for several weeks following the final application of rodenticide. At Hawai'i Volcanoes National Park, 25% of bait remained two weeks after application and by one month post-application most baits had disappeared (Spurr et al. 2003). Bait degradation rates are expected to be slower on the affected area than at Hawai'i Volcanoes National Park due to the more xeric environment; however, almost 100% of the bait applied on the affected area in September 2017 is expected to have either degraded or been consumed by the beginning of the game bird season in November 2017.

Chlorophacinone and diphacinone persist for a relatively short time in animal tissues compared to other rodenticides, such as brodifacoum (Erickson and Urban 2004). Data on birds are lacking, but a study on laboratory rats indicates that 90% of chlorophacinone is excreted within 48 hours and 100% within four days (Belleville 1981 in Erickson and Urban 2004). In mice, the half-life in liver is slightly more than 35 days (Vandenbroucke et al. 2008 in Anderson et al.

2011). For diphacinone, rats eliminated about 70% of the chemical within eight days, retaining about 20% in body tissues and mice eliminated most in four days, retaining only 7% in body tissues (Yu et al 1982 in Erickson and Urban 2004). In an extreme exposure scenario using diphacinone, residues in liver declined by one half-life in two days and it was estimated it would take 104 days for the highest residue measured in pig liver (3.22 μg/g) to decline to just below detectable levels (≤0.02 μg/g) (Fisher 2006).

Rodenticide toxicant residues detected in game birds are so low as to not pose appreciable risk to human health. At the highest concentration of diphacinone recorded in a game bird (0.56 mg/kg in a pheasant liver), the a 55-kg pregnant women would need to eat 2.46 kg of highly contaminated liver to reach the dose shown to cause fetal reabsorption in rats; a 55-kg person would need to eat 3.93 kg per day over multiple days to achieve the dose shown to slow blood clotting in lab rats (Eisemann and Swift 2006). The highest concentration of chlorophacinone reported in a game bird liver was 5.5 mg/kg in a turkey liver (Hosea 2000). To achieve the dose shown to cause reduced blood clotting times in three human volunteers, 20 mg (National Libraries of Medicine 2014), one would need to eat 3.58 kg of liver. Where reported, muscle tissue concentrations of rodenticide toxicant residues are typically less than 10% of liver concentrations.

Because the affected area is closed to public access and hunting, the proposed action would be conducted outside the bird hunting season, the very low number of turkeys detected over ten years of surveys in the affected area, and the medically insignificant concentrations of toxins recorded in game birds, there would be no effects to humans from the proposed action.

Cultural / Archaeological Resources

Project staff would be provided maps of known sites and advised on protocols to avoid disturbing archaeological resources. This would include instructions to avoid entering lava tubes and disturbing rocks on the ground surface. By adhering to these precautions, there would be no effects to cultural or archaeological resources from the proposed action.

CUMULATIVE EFFECTS

The NEPA regulations (40 CRF Sec. 1508.7) require federal agencies to consider cumulative impact of their actions. The regulations define cumulative effects as:

"…the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time"

The Council of Environmental Quality Handbook, *Considering Cumulative Effects Under the National Environmental Policy Act* (CEQ 1997), recommends focusing on each *affected* resource, ecosystem, and human community when completing cumulative effects analyses. Therefore, this cumulative effects analysis will focus on the cumulative effects of the Alternatives to birds, because only birds were predicted to be affected by the proposed action.

The study is located within PTA training lands, and the affected environment does not extend beyond the boundaries of the base. The following is a summary of the past, present, and reasonable foreseeable future actions within land ownership that could contribute to cumulative impacts associated with the Alternatives. Direct and indirect impacts from the alternatives will be analyzed with the following list of activities to determine the cumulative impacts for a given alternative.

Past, Present, and Reasonably Foreseeable Future Actions

<u>PTA Actions</u>:

PTA is the largest live-fire range and training installation in Hawai'i, and is a main tactical training area for military Mission Essential Task List training. PTA assets are geared toward live-fire range training, maneuver live-fire (*e.g.*, moving and shooting at targets, including combined arms live-fire exercises) on ranges, dismounted maneuver training outside live-fire ranges with no live-fire (at PTA), mounted non-live-fire maneuver on other leased lands, and artillery live-fire. PTA supports infantry brigades, division artillery, aviation brigade, and other divisional combat support and combat service support units. Training at PTA takes place on approximately 44,000 hectares (about 108,726 acres). Approximately 120 personnel (civilian and military) are assigned to PTA on a permanent basis. PTA comprises three geographic areas: the cantonment (*i.e.*, developed area), airfield, and training lands (including the Impact Area where there is unexploded ordnance).

Recent actions within the PTA were summarized in the Final EIS analyzing the impacts of the proposed Army Transformation of the 2nd Brigade, 25th Infantry Division (Light), to a Stryker Brigade Combat Team (SBCT) (U.S. Army Garrison-Hawai'i and U.S. Army Pacific 2004); and the Final EIS on the construction and operation of the infantry platoon battle course (IPBC) at PTA, Hawai'i (U.S. Army Garrison-Hawai'i and U.S. Army Pacific 2013); and the most recent Integrated Natural Resources Management Plan, 2010 -2014 (INRMP 2010). These documents' project descriptions are incorporated into this EA by reference, especially see U.S. Army Garrison-Hawai'i and U.S. Army Pacific (2004) Chapter 2, page 2-11 and Figure 2-6, and Chapter 8, page 8-5 (General SBCT Training); U.S. Army Garrison-Hawai'i and U.S. Army Pacific (2013), Chapter 2, pages 2-1 to 2-20. 2-35 to 2-37; and INRMP (2010), Sections 2.3.5.4, 2.3.5.5, 2.3.5.7, 2.3.5.8 to 2.3.5.8, 2.3.7.4, 2.3.7.5, 2.3.7.7, and 2.3.7.8.

On the PTA, the affected area includes only certain PTA training lands, namely small portions of Training Areas (TA) 17, 18, 19, 20, 23 and the Impact Area (See Figure 7). The study plots are within TA 22 and this is where most of the proposed action's effects would occur. The following describes actions within these affected areas. The following information on the Training Areas was gathered from the INRMP (U.S. Army Garrison 2010).

Training Area 18

TA 18 is grouped with TAs 9, 12, 13, 14, and 15. These training areas comprise 1,315 hectares (3,249 acres) and contain 37 kilometers (23 miles) of bordering and interior roads and trails. Companies to battalion-sized units use the areas for maneuver, bivouac, and live-fire activities about 250 days per year. There are 30 firing points, of which 26 are actively used for artillery or mortar fire. Mechanized ground excavation for artillery positions is allowed at three firing points. Fixed-wing aircraft and helicopters frequently overfly the area at low altitudes in support of various training missions. Area 18 contains a Forward Arming and Refueling Point (Range 17). At the Forward Arming and Refueling Point, ammunition is transferred to and from helicopters in cargo configuration only and refueling may occur. A portion of TA 18 is in the Kīpuka Kalawamauna Endangered Plants Habitat.

Training Areas 17, 19, and 20

TAs 17, 19 and 20 are grouped with TA 16. These training areas comprise 607 hectares (1,500 acres) and contain 17 kilometers (11 miles) of bordering and interior roads and trails. Parker Ranch owns about 409 hectares (1,010 acres) on the western portion (TAs 16 and 17). The ranch lands were leased to the Army for many years, but in 1997 the lease expired, and currently a daily lease fee is applied as appropriate. The sector provides maneuver, bivouac, and live-fire opportunities and contains six firing points (TA 17 has no live-fire). A training restriction in TA 17 prohibits the landing of helicopters on Pu'u Kapele. Portions of TAs 19 and 20 are in the Kīpuka Kalawamauna Endangered Plants Habitat and are subject to the following training restrictions:

- No overnight bivouac is allowed within 2,000 meters (one mile) of Kona Highway;
- No fires or use of any type of pyrotechnic or incendiary munitions;
- Foot march is permitted;
- Rocky outcroppings and caves must be avoided;
- Vehicles are restricted to established roads and are not permitted in areas protected by gates;
- Two yellow gates on New Bobcat Trail are not to be crossed, even if found open;
- Firing points 701 and 703 are off limits.

In addition, only foot access is allowed in the Kīpuka Kalawamauna fence unit for military personnel. Only the Natural Resources staff is allowed to use the roads within the fence unit. Like the rest of the Kīpuka Kalawamauna Endangered Plants Habitat, live-fire and pyrotechnics are not allowed.

Training Area 22

TA 22 comprises 8,373 hectares (20,690 acres) and contains 63 kilometers (39 miles) of bordering and interior roads and trails. The training area is used for maneuver training. Ground-training is infrequent and limited to a few helicopter insertions, because this area supports natural resource management activities. Live-fire does not occur at the firing points in TA 22. The area bounded by Bobcat Trail and adjacent to the Impact Area is a buffer area with limited access and is classified as a “high hazard” area.

Training Area 23

TA 23 comprises 4,656 hectares (11,505 acres) and contains 21 kilometers (13 miles) of bordering and interior roads and trails. The area is designated for ground maneuvers and bivouac outside of the Multi-Purpose Range Complex (Fig. 7). The area may support up to company-size units about twice a year when facilities throughout the installation are full.

Fence Units

A western fence unit was constructed to encircle TAs 19 and 22, and parts of TAs 17 and 20. The fence unit is approximately 8,700 hectares (21,500 acres) and connects with the northern section of the Kīpuka ‘Alalā fence unit. It also encloses the *Haplostachys haplostachya* plants in the southern parcel corner of the Keamuku Parcel. The fence is a solid hogwire fence, two meters (about six feet) tall. The purpose of the western fence is to offset training impacts at PTA by excluding ungulates, which reduces the browsing pressure on all listed and native plants within the fence unit. This in turn also benefits the Hawaiian hoary bat by minimizing habitat degradation to *Sorphora* Woodland. The continued suppression of ungulates in these fenced areas allows listed plant species and their habitats to regenerate naturally. The western fence unit has not change the current military use in the area.

Besides fencing and ungulate control, the Army is implementing several mitigation measures to lower the impact of their actions on natural resources. The mitigation measures are described in Chapter 8 of U.S. Army Garrison-Hawai’i and U.S. Army Pacific (2004) and Chapter 4, sections 4.91 to 4.9.4.3 of (U.S. Army Garrison-Hawai’i 2013). The aforementioned Chapter and Sections are incorporated in this EA by reference.

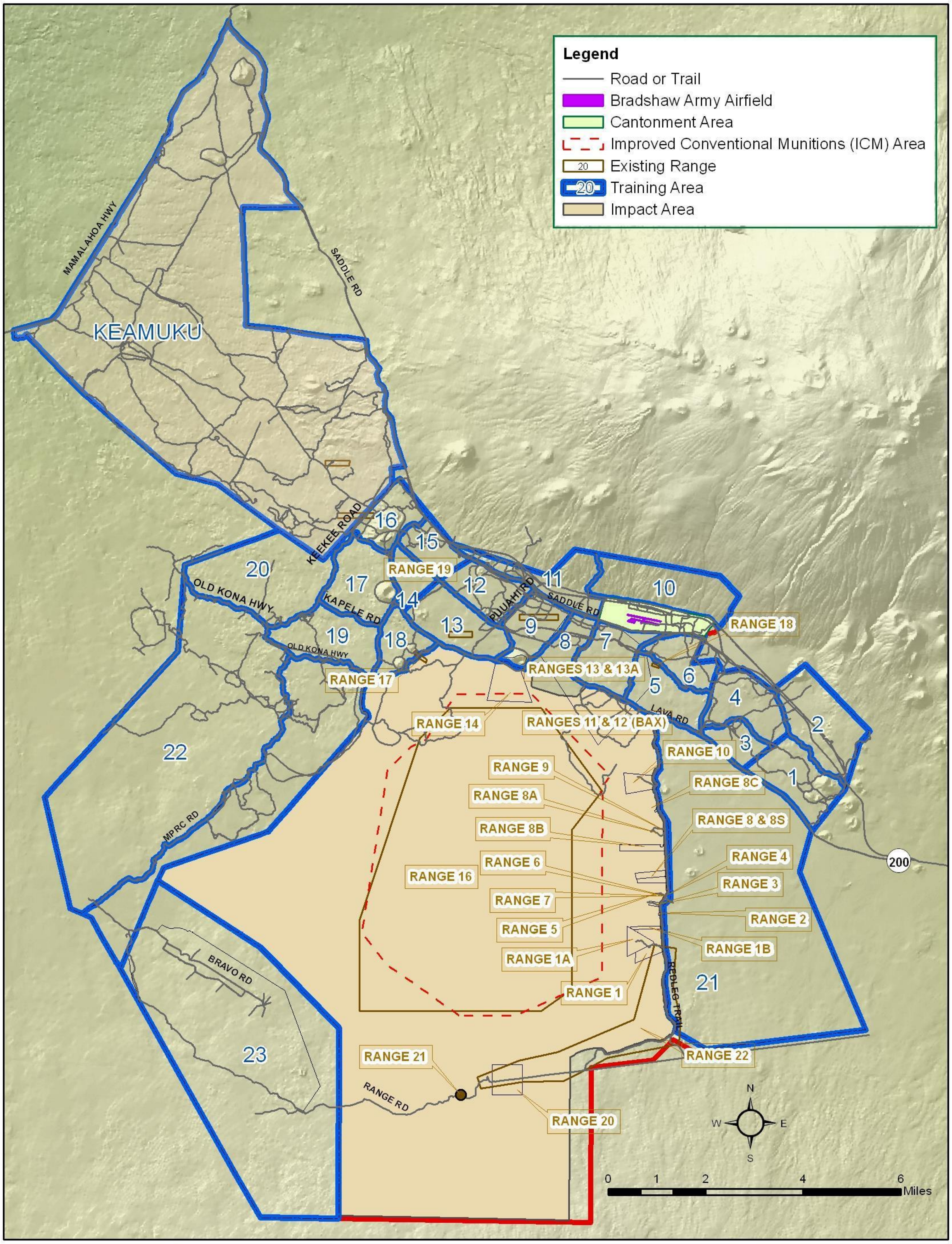

Figure 7. Existing Training Areas at PTA

Recreation hunting for game mammals and birds in the affected area has previously been allowed, but has not been permitted in the last three years (Doratt 2016b).

Summary of Effects from Past, Present, and Reasonably Foreseeable Future Actions

The activities carried out by the Army at the PTA and their biological effects are summarized in Table 8-1, page 8-6, in the 2004 Final Environmental Impact Statement (EIS) analyzing the impacts of the proposed Army Transformation of the 2nd Brigade, 25th Infantry Division (Light), to a Stryker Brigade Combat Team (SBCT); on pages 4-39 to 4-50 .in the U.S. Army Garrison-Hawai'i and U.S. Army Pacific (2013), and in sections 2.3.5.10 in the INRMP (U.S. Army Garrison 2010). The effects analyses from these aforementioned documents are included in this EA by reference.

<u>Impacts from SBCT</u>:
The Army concluded that impacts from increased risk of wildland fire that might be started by their activities and their construction and training activities could have significant impacts on sensitive species and sensitive habitat. The increased fire effects include loss of individuals of sensitive plant and wildlife species, soil erosion, increased risk of weed invasion, loss of native habitat, and disturbance to native seed beds.

Impacts from construction and training activities on general habitat and wildlife, and threats to migratory birds were found to be less than significant. These effects also include vegetation loss, soil erosion, increased risk of weed invasion, loss of native habitat, and disturbance to native seed beds, but because these activities would take place primarily in areas of non-native vegetation, significant impacts are not expected. Other impacts include disturbing general vegetation and wildlife, deterring wildlife from foraging, and creating other degradation effects due to elevated human activity, but these are not expected to cause significant effects. The operation of ranges is likely to displace wildlife species such as birds. Mobile wildlife would leave the area due to the disturbance by human presence and elevated noise levels. The increase in noise levels is not expected to adversely affect wildlife species at the PTA. Some migratory birds could be affected by colliding with antennas; none of these antenna towers are within the affected area. (Army Garrison-Hawai'i and U.S. Army Pacific 2004).

<u>Impacts from IPBC</u>

The general effects of the construction and operation of the Infantry Platoon Battle Course include: impacts from the spread of introduced species, disturbance to ESA-listed species or habitats, and disturbance to non-ESA-listed wildlife and habitat. These effects were determined to be significant but mitigable to less than significant (U.S. Army Garrison-Hawai'i 2013, Chapter 4, page 4-41).

As previously mentioned, invasive species pose a threat to native Hawaiian ecosystems. Impacts from the introduction of invasive species from construction activities occurring within the General Range Area would be expected to be significant, but mitigable to less than significant. Vegetation communities within the General Range Area could be disturbed by live-fire training. The use of certain types of ammunition increases the chances of starting fires in the impact area and within fire danger areas. These fires could facilitate the introduction and spread invasive plants and noxious weeds, which could place native plant species at competitive disadvantage.

The Army has developed and implemented a Fire Management Plan[2] to control the frequency, intensity, and size of fires on U.S. Army Garrison – Hawai'i lands in order to comply with federal and state laws and meet land stewardship responsibilities. Specific standard operating procedures for wildfire management at PTA are addressed in the plan.

Operation of ranges has the potential to displace various wildlife species, including migratory birds. Displacement could be caused by human presence in the area, as well as elevated noise levels. Wildlife entering into the impact area and associated surface danger zones[3] could be directly affected by ordnance or other munitions. The use of new ranges at PTA would not likely significantly impact wildlife or their habitats because the ranges would be constructed in previously disturbed areas. Wildlife species in or around these ranges are more tolerant of human activity, and it is assumed that wildlife species would have temporarily left the area due to the short-term noise.

Construction of the IPBC at the Western Range Area Alternative would impact the limited vegetation, wildlife, migratory birds, and habitats present in the area. Although construction of the IPBC would impact these biological resources, conservation measures would be implemented to limit the impacts.

Live-fire training occurring within the Western Range Area could result in the potential increase and frequency of wildfires, which could impact federally-listed plant species. Birds may be injured or killed by training activities while they are feeding or loafing in a surface danger zone at the IPBC or by vehicles transiting between the IPBC and the Cantonment Area while they are present on roadways. Birds traversing the impact area in flight or loafing undetected within the

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[2] The Integrated Wildland Fire Management Plan was accessed on January 23, 2017 and can be found at https://www.garrison.hawaii.army.mil/sbcteis/documents/FMP/fmp.htm

[3] <u>Surface Danger Zones</u>: The ground and airspace designated within the training complex (to include associated safety areas) for vertical and lateral containment of projectiles, fragments, debris, and components resulting from firing, launching, or detonation of weapon systems to include explosives and demolitions.

impact area could be killed by a direct hit of a round, shrapnel, or fragments from a detonation, or by compression due to blast overpressure resulting from detonation of rounds from these weapons. Flying birds may be struck and killed by helicopters, fixed wing aircraft, or rounds as they are shot into the impact area on PTA. However, there have been very few of these collisions to date.

Live-fire training impacts from projects within the Western Range Area would disturb vegetation, wildlife, migratory birds, and wildlife habitats. Ammunition rounds from small arms could damage vegetation and habitats or disturb wildlife that could result in some loss of the resource. Any visual flash or sound effects simulators used on the IPBC could ignite a wildfire that may result in damage or loss of known habitat. Vegetation in the area can recover from events such as wildfires and damage caused by bullets. Due to the sparsely vegetative nature of the Western Range Area location, wildfire within the boundaries of the proposed IPBC is unlikely. However, the land surrounding the proposed project area is more prone to wildfire; therefore, under the Service's 2013 BO (USFWS 2013a), illumination rounds are prohibited.

Maneuver training impacts within the Western Range Area could result in the potential disturbance of federally listed species and their habitat, the risk of fire, habitat fragmentation, and dispersal of introduced plant seeds from foot or vehicular traffic and other activities associated with military training. Training at the IPBC would be primarily dismounted, thereby limiting maneuver on the range to foot traffic. Foot traffic would have less of an impact than the presence of large vehicles for tactical maneuvers. In general, vehicles would remain on established roads. The new access road to the IPBC would be sited to avoid known resources where necessary. Maneuver training within the Western Range Area Alternative could introduce invasive plants and noxious weeds. To prevent the introduction of non-native plants and weeds to the Western Range Area Alternative, the maneuver training would follow established standard operating procedures at PTA including the use of washracks. The effect of introduced nonnative plants is considered to be significant, but mitigable to less than significant.

Cumulative Effects

<u>Alternative A</u> - No Action

Because taking no action would result in no impacts to physical characteristics, wetlands and water resources, recreation, cultural resources or human health and safety, there would be no cumulative effects to these resources. Under the no action alternative, there would be some short-term effects to endangered plants and invertebrates and birds, from continued predation from mice and game and migratory birds, but because no actions would be taken there would be no cumulative effects to these resources. In addition, while there would be no direct or indirects affects to birds under the no action alternative, continuing affects to birds due to activities being conducted by the Army at the PTA Military Reserve would occur. These activities and their effects are described in U.S. Army Garrison-Hawai'i and U.S. Army Pacific (2004), U.S. Army Garrison-Hawai'i and U.S. Army Pacific (2013), and INRMP (2010).

<u>Alternative B</u> - Trial with both diphacinone and chlorophacinone (Proposed/Preferred Action)

<u>Physical Characteristics</u> – There would be no cumulative effect to physical characteristics in the affected area because there would be are no direct or indirect effects to the physical characteristics within the affected area.

<u>Biological / Ecological Resources</u>

Vertebrates Listed under the Endangered Species Act

Hawaiian hawk (ʻio), Hawaiian hoary bat (ʻōpeʻapeʻa), Petrels (ʻuaʻu and ʻakēʻakē), and Hawaiian goose (nēnē) would not be directly or indirectly affected by the proposed action, therefore there would be no cumulative effects to these species

Birds Protected by the MBTA that are not listed under the ESA

ʻŌmaʻo, ʻApapane or ʻAmakihi - Because there would be no direct or indirect affects to these birds from the proposed action, there would be no cumulative effects to these species.

Pueo –The proposed action is unlikely to have direct or indirect effects on pueo; however, there is the potential to for 2 adults and potentially 3 fledged young to be injured due to sublethal effects from the proposed project. The bird monitoring data indicate that pueo are uncommon on the PTA, however, given the general nature of the monitoring methods some pueo that were present may not have been detected. Regardless, the proposed action would occur during one year only, and so any effect to pueo on the PTA would be temporary. If a pair was lost, or their nesting attempt failed because of this action, it is likely they would be replaced by other owls needing a territory, or they would have subsequent nesting attempts unaffected by future rodenticide trials. The other PTA activities were considered to be less than significant on migratory bird species; therefore, it is likely that the loss 2 adults and 3 fledged young when added to the effects of PTA activities would be negligible to the local pueo population.

Northern cardinals- It is possible that 0 to 1 cardinals would be killed or sublethally affected by the proposed action. It is likely that the loss of 0 to 1 birds when added to the effects of PTA activities would be negligible. This species is relatively abundant in the area, the action would exert lethal effects for only a short period of time, and PTA activities were considered to be less than significant on these general wildlife species.

House finches - It is possible that 20 to 40 finches would be killed or sublethally affected by the proposed action. It is likely that the loss of 20 to 40 birds when added to the effects of PTA activities would be negligible. This species is relatively abundant in the area, the action would exert lethal effects for only a short period of time, and PTA activities were considered to be less than significant on these general wildlife species.

Northern mockingbirds - It is possible that 1 to 5 mockingbirds would be killed or sublethally affected by the proposed action. It is likely that the loss of 1 to 5 birds when added to the effects of PTA activities would be negligible. This species is relatively abundant in the area, the action would exert lethal effects for only a short period of time, and PTA activities were considered to be less than significant on these general wildlife species.

Kōlea - It is possible that 0 to 1 kōlea would be killed or sublethally affected by the proposed action. It is likely that few kōlea inhabit the area, probably because their preferred habitat is not present in the proposed action's affected area. The local kōlea population would not be in affected area, and the action would exert lethal effects for only a short period of time, and PTA activities were considered to be less than significant on migratory bird species. Therefore, it is likely that the loss of 0 to 1 birds when added to the effects of PTA activities would be negligible to the local kōlea population.

Game Birds

All of the game birds on Hawai'i are non-native. As earlier described, DOFAW characterizes their recreational public hunting program as a complex endeavor, as it entails consideration of ensuring the persistence of native species and ecosystems. Public hunting can provide a useful tool in controlling game mammals on public and private lands where control is needed and funds are scarce. Activities on the PTA can result in disturbance or mortality of game birds, but these activities are occurring in areas already disturbed and mitigation measures are being taken to lessen impacts.

Chukar and kalij pheasant – It is possible that three to six birds of each species would be killed or sublethally affected by the proposed action. It is likely that the loss of three to six birds when added to the effects of PTA activities would be negligible. These species are relatively abundant in the area, the action would exert lethal effects for only a short period of time, and PTA activities were considered to be less than significant on these general wildlife species.

Erckel's and black francolin – It is possible that four to eight Erckel's and black francolin, each, are likely to be killed or sublethally affected by the proposed action. It is likely that the loss of four to eight birds of each species when added to the effects of PTA activities would be negligible. These species are relatively abundant in the area, the action would exert lethal effects for only a short period of time, and PTA activities were considered to be less than significant on these general wildlife species.

California quail – It is possible that 20 to 30 California quail are likely to be killed or sublethally affected by the proposed action. It is likely that the loss of 20 to 30 California quail when added to the effects of PTA activities would be negligible. This species is abundant in the area, the action would exert lethal effects for only a short period of time, and PTA activities were considered to be less than significant on these general wildlife species.

State-protected Alien Birds

African silverbill and yellow-fronted canaries – It is possible that the proposed action would kill or sublethally affect 25 to 50 individual African silverbill and yellow-fronted canaries. These species are not native to Hawai'i, but they are abundant in the area. Non-native birds have detrimental effects on native species and habitats. Because the action would exert lethal effects for only a short period of time, and PTA activities were considered to be less than significant on these general wildlife species, it is likely that the cumulative effects to these species would be negligible.

Vertebrates Without Protected Status

Ungulates – There are very few ungulates within the affected area due to fencing and control activities within the fences, and any effects to these species from the proposed action is expected to be very low. Because of their very low abundance, effects to these species from the proposed action when added to the effects of other activities in the area are also expected to be negligible.

Feral dogs, feral cats, mongooses, and black rats – These species would be expected to occur in the study area, estimates of their population sizes are unknown. It is likely that the proposed action would kill or sublethally affect an unknown number of individuals of these four species. Because of their ubiquity, effects to these species from the proposed action when added to the effects of other activities in the area are also expected to be negligible.

Japanese white-eye – It is possible that 12 to 18 white-eyes are likely to be killed or sublethally affected by the proposed action. It is likely that the loss of 12 to 18 white-eyes when added to the effects of PTA activities would be negligible. This species is abundant in the area the action would exert lethal effects for only a short period of time.

All of the species in this category are non-native and considered to have detrimental impacts on native species and habitats.

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Appendix 1. Rodenticide labels and experimental use permits.

To be included in Final Draft.